

# ANNALS of SURGERY

A Monthly Review of Surgical Science and Practice

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(Rheumatism,  
Streptococcal  
Infection)  
Iodides  
Salicylates  
Sulphonamide

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## PERICARDIOTOMY FOR SUPPURATIVE PERICARDITIS\*

BY EUGENE H. POOL, M.D.

OF NEW YORK, N. Y.

ATTENDING SURGEON TO THE NEW YORK HOSPITAL

THIS paper is based largely upon a case of suppurative pericarditis which was observed on the Second Surgical Division of the New York Hospital. It illustrates certain principles of treatment which I wish to emphasize, notably the technic of pericardiotomy and the post-operative treatment by the Carrel-Dakin method.

Suppurative pericarditis is not an excessively rare lesion, although operations for its relief are relatively infrequent. Stone found purulent pericarditis in 14.5 per cent. of 300 patients who had died of pneumonia. None of the forty-four cases had been operated upon. Stone's figures, however, are much higher than those of most observers. The variance in the statistics is due to the fact that the incidence of this complication of pneumonia varies greatly in different epidemics and in different years. The lesion may also develop secondarily to other infections besides pneumonia; may occur primarily, and may follow infection from without through a wound. A considerable proportion of the cases occur in children (Gill). The diagnosis of pericardial effusions, according to Stone, should offer little difficulty when the amount reaches 300-500 c.c. Yet, Osler states that "probably no serious disease is so frequently overlooked by the practitioner." The explanation is that the condition is frequently not thought of and its signs not sought. If there is doubt as to the purulent character of the exudate, this is readily demonstrated by paracentesis.

Because the involvement of the pericardium is usually secondary in the course of a general sepsis, and often constitutes a terminal infection, medical men have not been inclined to refer these cases to the surgeon. As a result, operations in general have not been undertaken sufficiently early nor often. Although the prognosis is extremely grave in such secondary infections of the pericardium, it is not necessarily hopeless, as has been repeatedly demonstrated by the recovery of apparently moribund patients.

\* Read at meeting of New York and Philadelphia Surgical Societies, December 8, 1920.

The report of the case is as follows:

The patient was a boy of nine years who had always been robust and healthy until the present illness. About nineteen days before admission he had a violent chill followed by cough and vomiting. On the following day the condition was recognized as pneumonia involving the right lung. Three days later the left lung also became involved. The temperature ran between 104° and 105°, and the patient became delirious. Three days before admission to the hospital, the attending physician suspected suppurative pericarditis. Dr. E. Cussler, who was called in consultation, concurred in the diagnosis and referred the patient to the New York Hospital.

*Physical Examination* (on admission).—The boy was emaciated, flushed, dyspneic and evidently acutely ill. Temperature, 103°; pulse, 120; respiration, 48.

**Chest.** The expansion was limited on both sides; the excursions shallow and rapid. Fremitus was decreased in the right mid-axilla down to the base. Percussion was slightly hyper-resonant throughout, except in right chest from anterior axillary line to the outer border of the scapula. This area was dull. Breath sounds in this area were almost absent. Throughout the remainder of the chest the breath sounds were harsh and high pitched with numerous moist râles most marked over the upper right lobe anteriorly.

**Heart.** The apex impulse was absent; percussion showed enlargement both to the right and left; no murmurs or accentuation were noted. At the base there was heard a slight pleuro-pericardial friction sound. All sounds were very distant and muffled.

#### PERCUSSION OF HEART

Space	To Right	To Left of Midline
2nd	1 cm.	2 cm.
3rd	2 cm.	4 cm.
4th	2 cm.	6 cm.
5th		9 cm.
6th		10 cm.

**Extremities**—No oedema. **Blood**—Red blood-cells, 4,640,000; haemoglobin, 88 per cent.; white blood-cells, 19,800; polymorphonuclears, 90 per cent. **Urine**—10.25-acid-albumin trace, granular casts. X-rays showed pericardial effusion with sacculated fluid in external part of right chest (*cf.* Fig. 1).

*Operation* (April 6, 1920).—Pericardiotomy and right thoracotomy for empyema. Ethyl chloride ether anaesthesia.

The pericardium was aspirated just mesial to the outer margin of dulness in sixth space and pus obtained. Curved incision from fifth rib at left border of sternum down to seventh rib, then curving outward along seventh, in all about three inches. The flap thus formed was lifted outward from the bony structures and about one and one-half inches of the costal cartilages of the sixth and seventh ribs were removed. The internal mammary was ligated above and below. The triangularis sterni was cut and the pericardium exposed. Two per cent. novocaine was injected in the pericardial

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and the pericardium opened vertically about one-half inch from the sternum. On opening the pericardium a large quantity of thick pus exuded. This was allowed to escape slowly; then the opening was enlarged. A finger introduced revealed a considerable amount of thick fibrin. This loosely bound the heart to the parietal pericardium. It was freed with the finger, and masses of it were removed with forceps. Pericardium on each side was then sutured to the superficial soft parts and a small tube and a rolled rubber dam introduced.

Needle was introduced in midaxillary line, right side, sixth interspace, and thick pus obtained. Thoracotomy in intercostal



FIG. 1.—On admission.

space and large drainage tube introduced with Auchincloss apparatus attached. A rapid intercostal thoracotomy for empyema was performed without the evacuation of fluid at the time in order to diminish shock.

*Post-operative Course* (abstract of notes).—April 8th, second day, drains removed and two Carrel tubes, open at ends and without lateral perforations, inserted to depth of wound, about five inches. Dakin's solution was introduced very slowly by gravity; 10 c.c. every hour through each tube. The wound was dressed daily, following the Carrel technic, tubes being removed and fresh tubes reinserted.

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By means of a back rest the boy was kept in a sitting position most of the time.

April 9th. General condition very good. At dressing patient was lifted and turned. Only about six drops of thick, yellow pus escaped.

April 11th, fifth day, empyema tube removed for first time, little

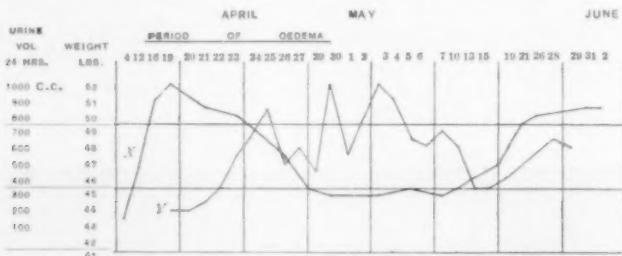


FIG. 2.—Chart showing relation between weight and urine during and after edema. Line Y indicates urine c.c. twenty-four hours. Line X indicates weight.

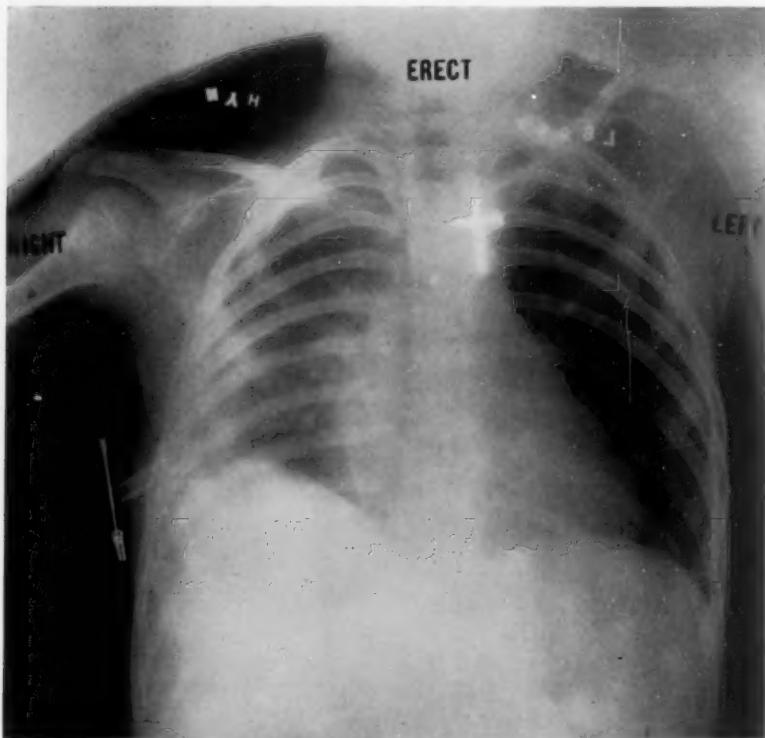


FIG. 3.—One month after admission.

pus and small cavity. Large tube reintroduced and through it Carrel tube inserted. Ten c.c. of Dakin solution introduced thereafter every hour.

Pericardial wound. Discharge now thin and mucoid, not purulent. Only one Carrel tube introduced.

## PERICARDIOTOMY FOR SUPPURATIVE PERICARDITIS

April 16th. Moderate discharge from pericardium. Abdomen distended.  $\text{\textcircled{O}}$ edema of face, scrotum, legs and abdomen. Patient's weight increased and urine excretion was low (*cf.* Fig. 2). Urine showed trace of albumin and few granular casts. Tincture digitalis was administered, M 140 in five days. Turned on face to allow fluid to gravitate from pericardium, little escaped. Scant discharge from empyema. X-ray showed thickened pleura on right side. Heart shadow still enlarged to left. During the first ten days temperature fluctuated from  $100^{\circ}$  to  $104.6^{\circ}$ . From this time, with one exception, it did not exceed  $101^{\circ}$ .

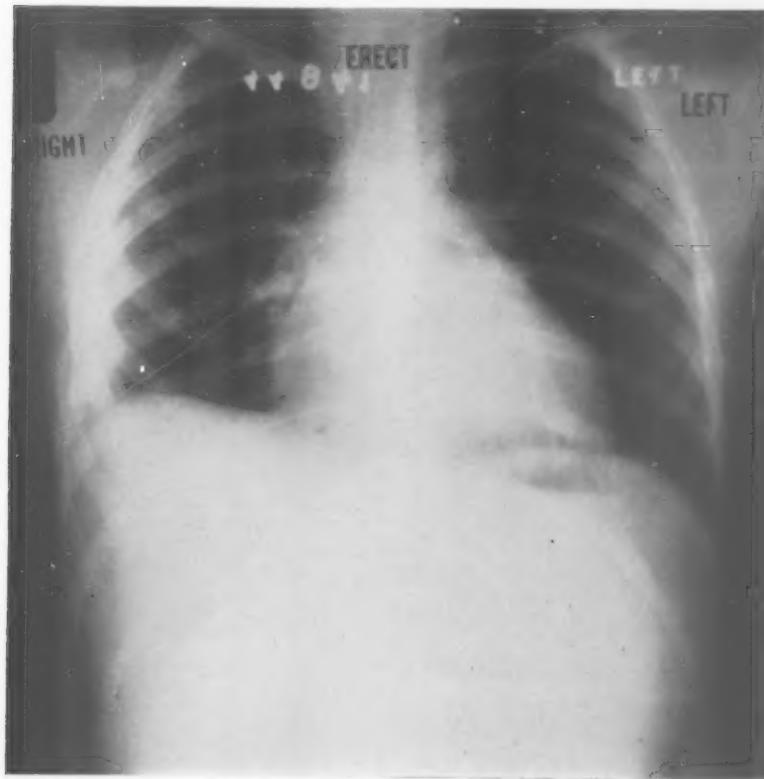


FIG. 4.—Two months after operation.

April 20th. Patient's general appearance improved. Temperature,  $99.4^{\circ}$ . Pulse of good quality. Not dyspnoeic.  $\text{\textcircled{O}}$ edema of face and legs less.

April 23rd. Condition improved. Discharge less. Turned on face, practically no discharge.  $\text{\textcircled{O}}$ edema of abdomen and scrotum less. With the clinical improvement the weight diminished and the urine increased.

April 30th. General condition markedly improved. Small irrigation catheter passes inward four inches. Cavity held only about 2 c.c. Marked pulsation of whole precordial region.  $\text{\textcircled{O}}$ edema practically gone. It was believed that the edema was due to myocarditis.

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May 4th. Very little discharge from wounds. General condition improving.

May 11th. Tube shortened gradually from this time about one-quarter inch every two to three days. X-ray showed thickened pleura and pleuro-pericardial adhesions on right side. Some infiltration of right lung (Fig. 3).

May 25th. Pericardial wound very slight discharge. Tube reinserted.

May 28th. Empyema wound, no drainage. Pericardial wound practically no drainage. Drain removed. Condition good.



FIG. 5.—Patient on discharge June 4, 1920, two months after operation.

June 1st. X-ray showed thickened pleura, lower right (Fig. 4).

June 2nd. Examination by Dr. W. R. Williams. Mesial part of precordial scar retracted in systole. Cardiac dulness extends 2 cm. to right of midline in fourth and fifth spaces. To the left 3 cm. in second; 5 cm. in third; 9 cm. in fifth space. Heart action regular and of good quality; no thrills nor murmurs. On breathing expansion of both sides of chest good. Empyema scar at level of eighth rib; opposite this level, both in front and in back, resonance is diminished, as are also fremitus, breathing and voice. Over rest of lungs signs are normal. No râles heard at any point.

## PERICARDIOTOMY FOR SUPPURATIVE PERICARDITIS

June 4th. Discharged from hospital. General condition excellent (Fig. 5).

On October 19, 1920, Doctor Williams reported as follows: On inspection left side of chest bulges little more than right. Apex impulse definite in fifth space 8 cm. to left of midline. No retraction of chest wall with systole.

Cardiac dulness extends 3 cm. to right and 8 cm. to left of midline. Apex impulse is felt in the fifth space 8 cm. to left of midline. P-2 is greater than A-2. No murmurs heard. Rate 92, regular, sounds have good muscular quality.

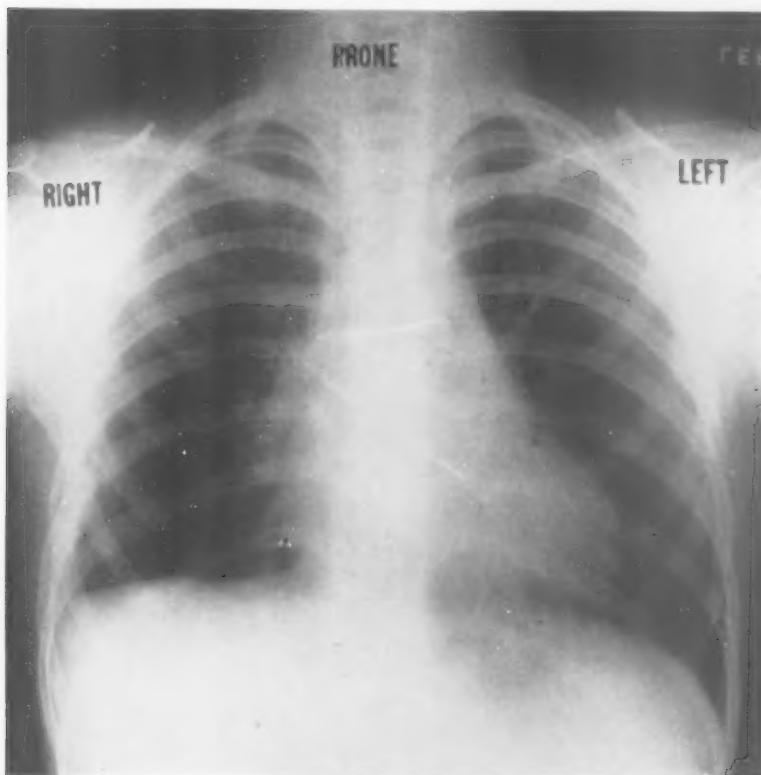


FIG. 6.—Six months after operation.

*Fluoroscopic Examination.*—Movements of diaphragm normal—no evidence of pleural adhesions. The heart shadow somewhat more horizontal than usual; transverse diameter of the shadow was 11 cm. No systolic retraction of any ribs or costal cartilages could be seen (Fig. 6).

*Electrocardiographic Report* (Dr. Harold Pardee, Fig. 7).—The tracing of May 6th, taken when the pericardium was open and draining, shows the presence of a slight degree of right ventricular predominance. The "T" wave is turned downward in all three leads which indicates that the myocardium is abnormal. The "T" wave also shows a curious upward curve in lead I between the "S" wave

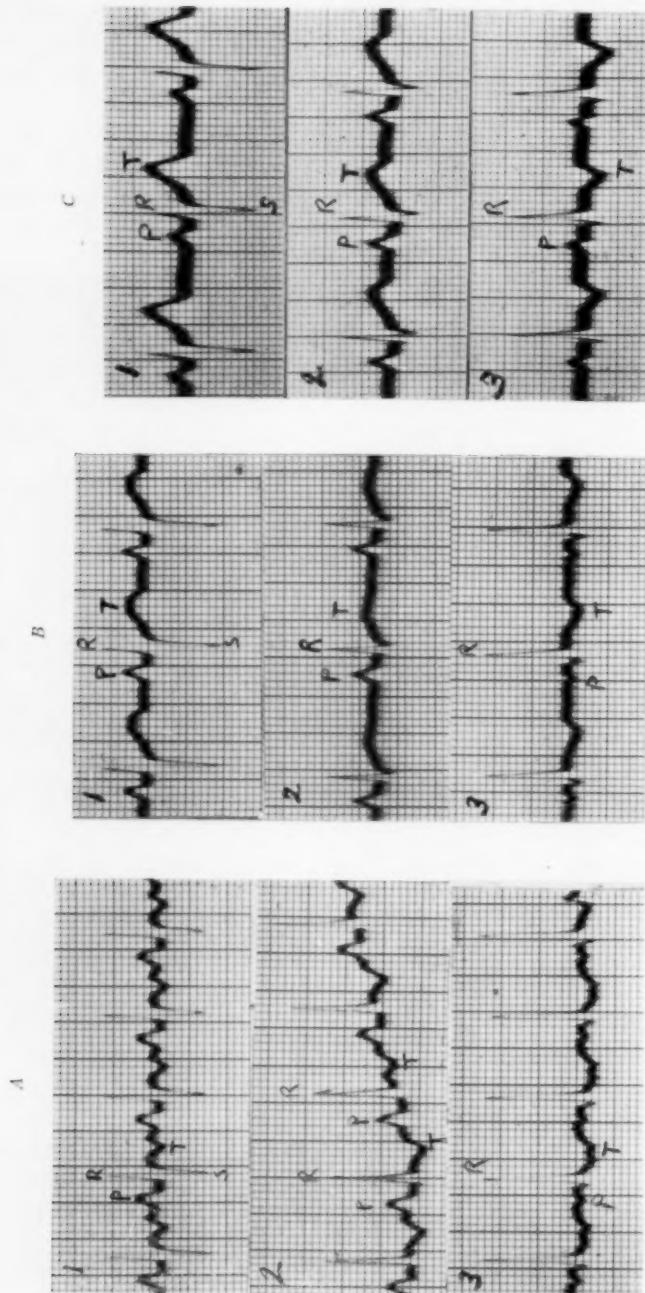


FIG. 7.—Electrocardiograms taken on three different occasions. In each record the curves are by leads 1, 2 and 3 from above downward. The vertical lines represent time and are 0.4 second apart—one-fifth of a second between every fifth line. Movements of the curve across the horizontal lines are due to variations in the amount of the heart's current, the space between ten abscissæ representing one millivolt. Record A: May 6, 1929. Record B: June 11, 1929. Record C: October 18, 1929.

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and the downward peak of the "T" wave, which is often found when the myocardium is the seat of a focal process. The auricular waves are normal and the "P"- "R" interval is normal, showing that there is no disturbance of the conduction system between the auricles and ventricles.

The record of June 11th, taken when the wound was closed and the patient up and about, shows a more normal-appearing electrocardiogram. The right predominance is still present and is more marked, but the "T" wave does not show the abnormal direction which it did in the previous record. This is probably due to an improvement in the myocardial condition which was previously present.

The record of October 18th shows very little change from that of June 11th, except that the right ventricular predominance is still more marked. This increase of the right ventricular predominance is probably due to the mechanical difficulty which this ventricle meets in contracting; possibly as the result of adhesions.

Summary of bacteriologic examinations made by Doctor Wheeler. The first cultures in this case were made at the time of operation on April 6th. Specimens of pus from pericardium and from pleural cavity were placed in tubes of broth, from which blood agar plates were inoculated. A pure culture of pneumococcus, Group IV, was obtained from the pericardial pus; the culture of pus from the pleural cavity remained sterile ten days. The pneumococcus, Group IV, isolated from the pericardium showed characteristic colonies on blood agar plates, had a distinct capsule, was bile-soluble, fermented inulin and was not agglutinated by any of the three types of anti-pneumococcus immune serum.

On April 16th, ten days after operation, cultures of pus from pericardium showed a pure growth of streptococcus haemolyticus. The haemolysis produced was slight, but the organism grew typically in long chains, in broth, had no capsule, was not soluble in bile, and did not ferment inulin. No pneumococci were found in these cultures. Cultures of pus from pleural cavity showed a haemolytic streptococcus similar to that just described and many colonies of staphylococcus aureus.

Repeated cultures of pleural and pericardial exudates made at intervals of one to five days always showed a typical haemolytic streptococcus producing well-marked haemolysis on blood agar plates. No pneumococci were found in any of these cultures. At times secondary invaders were present; staphylococcus albus, a non-motile, non-liquefying, gram-negative bacillus and a diphtheroid bacillus; but these disappeared subsequently and the final cultures showed in each instance a pure growth of streptococcus haemolyticus.

When last seen in December, eight months after the operation, the boy was apparently in normal health and was able to exercise as before the operation without embarrassment. The two costal cartilages apparently had reformed except at junction with sternum, where a narrow cleft could be felt.

*Technic of Pericardiectomy.*—Numerous procedures have been recommended for drainage in suppurative pericarditis. They need not be reviewed in detail. Two features, however, have become generally accepted: first, that the approach and drainage should be to the left of the sternum, and second, that no procedure should be employed which does not drain the lowest part of the pericardium. Although patients have recovered after removal of fourth, fourth and fifth, and fifth cartilages and incisions through the fourth or fifth space, such methods of approach should not be elected, since they do not provide a direct tract beneath the heart to the deep recesses on each side of the inferior vena cava.

Methods which are planned to drain the dependent part of the pericardium include resection of the sixth cartilage (Voinitsch, Kocher);

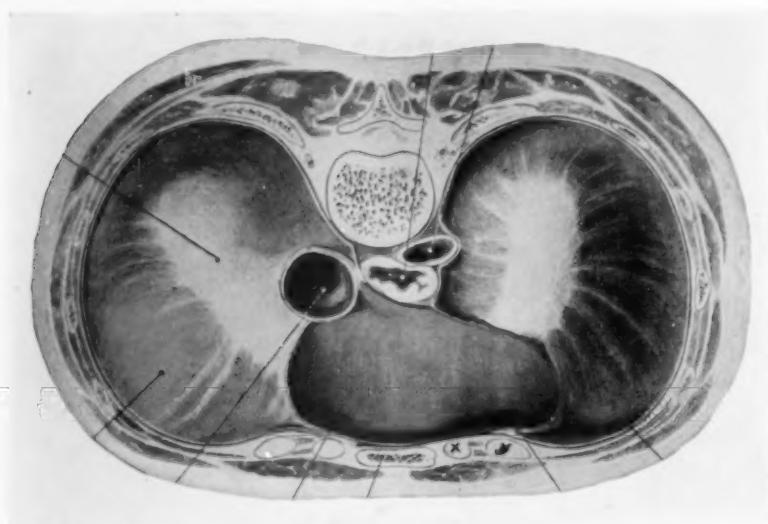


FIG. 8.—Diaphragmatic portion of parietal pericardium X = seventh costal cartilage; Y = sixth costal cartilage. (From Corning.)

resection of the fifth and sixth cartilages (Delorme et Mignon); resection of the sixth and seventh cartilages with adjacent sternum (Voinitsch, Rehn); resection of the seventh (Mintz), and the epigastric route (Allingham). The epigastric or subcostal approach through the diaphragm is a rapid but rather blind procedure; moreover, it endangers the peritoneum and is very limited in extent, especially in adults (Cotts and Rowlands). Since this method cannot be recommended, the indications would appear to demand some procedure by which drainage is secured through resection of one or more of the lower costal cartilages.

Resection of a single cartilage, preferably the sixth, is not adequate for prolonged drainage. The relatively narrow tract rapidly contracts. It cannot be kept open with a rigid tube, as in an empyema, on account of contact of the tube with the heart. If the case does not do well and a deep accumulation of pus is suspected, exploration and reintroduction

## PERICARDIOTOMY FOR SUPPURATIVE PERICARDITIS

of drain is difficult and necessitates some trauma to the heart. These disadvantages of the method were forcibly demonstrated in a personal experience. Accordingly, in the case here reported, it was decided to make a more extensive exposure. Resection of the fifth and sixth cartilages was considered but rejected because the drainage is not as low as possible, and resection of the sixth and seventh cartilages was elected. This procedure was a marked improvement, yet it did not give as free exposure as is desirable. An effort, therefore, was made to plan a more satisfactory operation which will give ample exposure and provide the essential dependent drainage; and with this object the anatomy of the parts was reviewed.

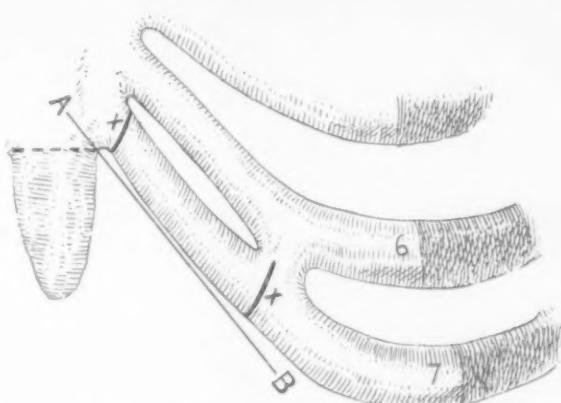


FIG. 9.—Mintz method, resection of seventh cartilage.

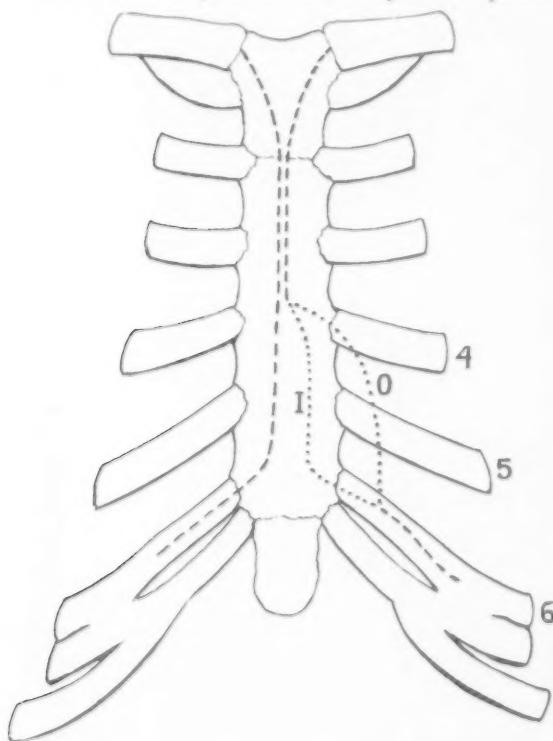


FIG. 10.—Reflection of pleura. On left side the anterior limits of pleura may lie anywhere between the dotted lines. The outer position (o) is the most frequent; the inner (i) the least frequent.

The relations of the heart and pericardium to the thoracic wall need not be outlined. Admirable descriptions are given by Moritz, Corning, and others. The diaphragmatic portion of the parietal pericardium, however, must be referred to, since it is along this surface that the drain should lie. Illustration shows relation of this surface to thoracic wall (Fig. 8). Since the sternal portion of the seventh cartilage is above the diaphragm and usually overlaps the pericardium, removal of this part of the cartilage is indicated to ensure dependent drainage. Mintz even limited his operation to resection of the seventh cartilage (Fig. 9).

The anterior reflection of the left pleura is relatively close to the sternum, yet varies somewhat. The limits most often noted are defined in the illustration (Fig. 10). With distention of the pericardium the reflection is said to be displaced slightly outward; moreover, adhesions may occur and close to some extent this part of the pleura by agglutination between its surfaces. However, reliance cannot be placed on these factors. It is obvious that a pericardial incision parallel to the ribs is

likely to open the pleura unless the incision be extremely short; while a vertical incision close to the sternum will usually safeguard the pleura. The first requisite, therefore, is that the pericardium be opened in a vertical direction close to the sternum.

Study of the bony thoracic structure shows that it is subject to wide variations, but the general arrangement as evidenced by dissections and illustrated in anatomies (Fig. 11) shows a close relationship between the sixth and seventh cartilages with little intervening space. Moreover, the fifth space is often narrow. Consequently, the removal of

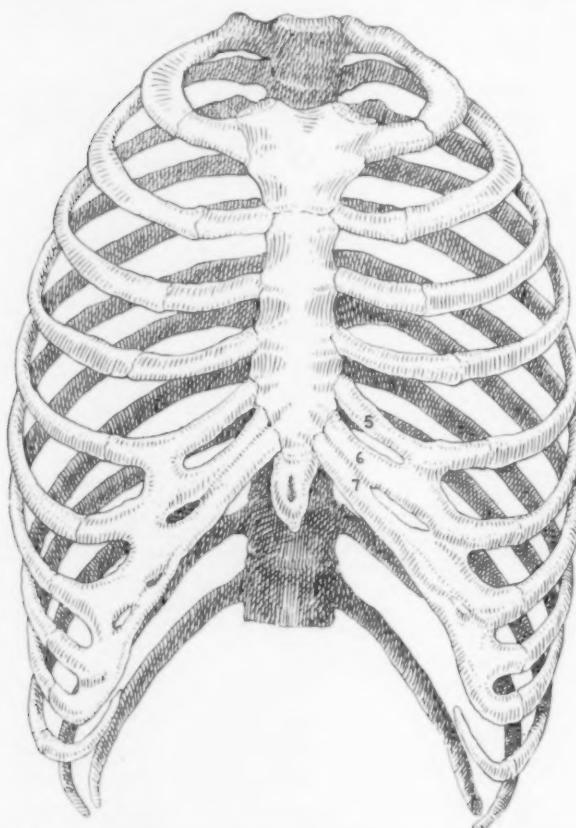


FIG. 11.—Bony structure of thorax. (From "Gray's Anatomy," Twentieth Edition, 1918, p. 116, Fig. 112.)

the sixth and seventh cartilages gives relatively little exposure in a vertical direction. The fourth space, on the other hand, is wide; consequently, the additional removal of the fifth cartilage adds greatly to the exposure in the vertical direction while it adds little to the severity of the operation. Therefore, if it is accepted that a vertical incision in the pericardium should be made, an adequate opening is best obtained by the removal of portions of the fifth, sixth, and seventh cartilages (Fig. 12). This allows approximately a two-inch incision in the adult as demonstrated on the cadaver.

Such a relatively extensive exposure has the additional advantage of favoring post-operative drainage. The importance of this factor cannot

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be too strongly emphasized. As Ballance states, "In reading the records of cases of suppurative pericarditis, one is struck with the almost universal difficulty experienced in maintaining drainage." The situation of the exudate in the distended pericardium explains this (cf. Figs. 13 and 14). In a large proportion of cases pus accumulates after operation in the depths of the pericardium, especially in the left cul-de-sac. The heart descends over this pocket and the lung intrudes laterally, assisting in shutting it off. The drainage track may thus easily become blocked. Further, the incision through the soft parts tends to close with surprising rapidity as has been emphasized by Rhodes and others. With tract thus narrowed and blocked re-introduction of a drain or exploration of the depth of the wound is a difficult, dangerous, and blind procedure. A liberal exposure will tend to avoid these difficulties.

The following operative procedure is suggested. It is a modification of the method presented by Delorme and Mignon.

The incision (Fig. 15) begins at middle of sternum at level of the lower margin of fourth costal cartilage; curving it passes downward and to the left to upper margin of chondrosternal junction of fifth; then downward close to the left edge of sternum, crossing the fifth and sixth cartilages to the middle of the seventh cartilage; curving outward it follows the seventh cartilage. The soft parts are freed and retracted, the resulting wound being an ellipse. The seventh costal cartilage is divided at sternum. The soft parts are detached along its borders and the cartilage is lifted. It is easily freed from the perichondrium posteriorly. A complete subchondral resection is not attempted because the perichondrium anteriorly and at the borders is firmly adherent and is separated with difficulty. The cartilage is fractured about two inches from its sternal end

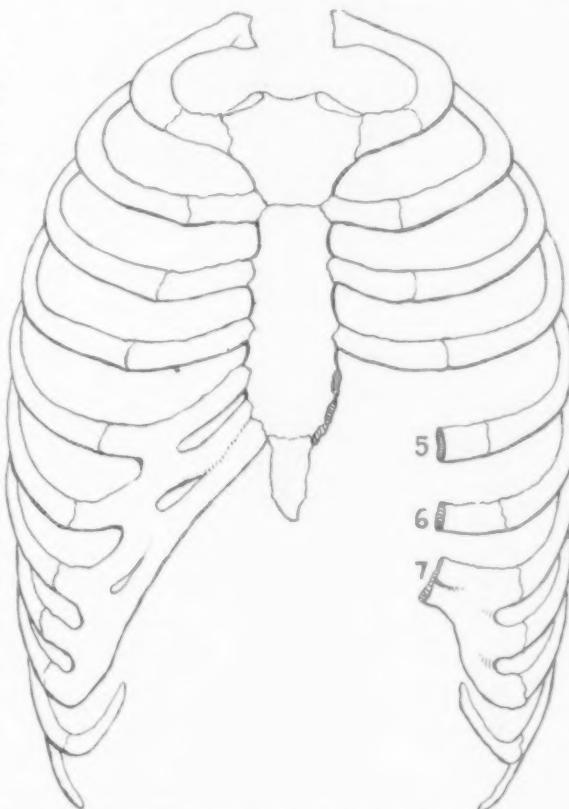


FIG. 12.—Exposure after removal of fifth, sixth and seventh cartilages.

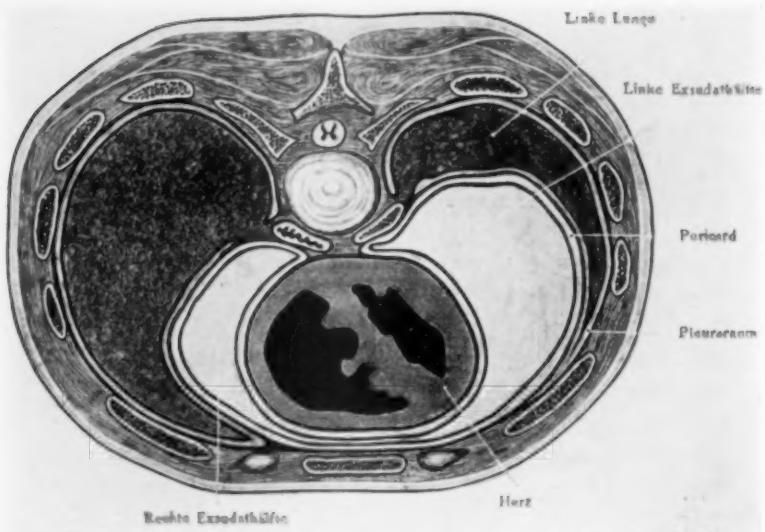


FIG. 13.—Position of exudate in distended pericardium. (Curschman.)

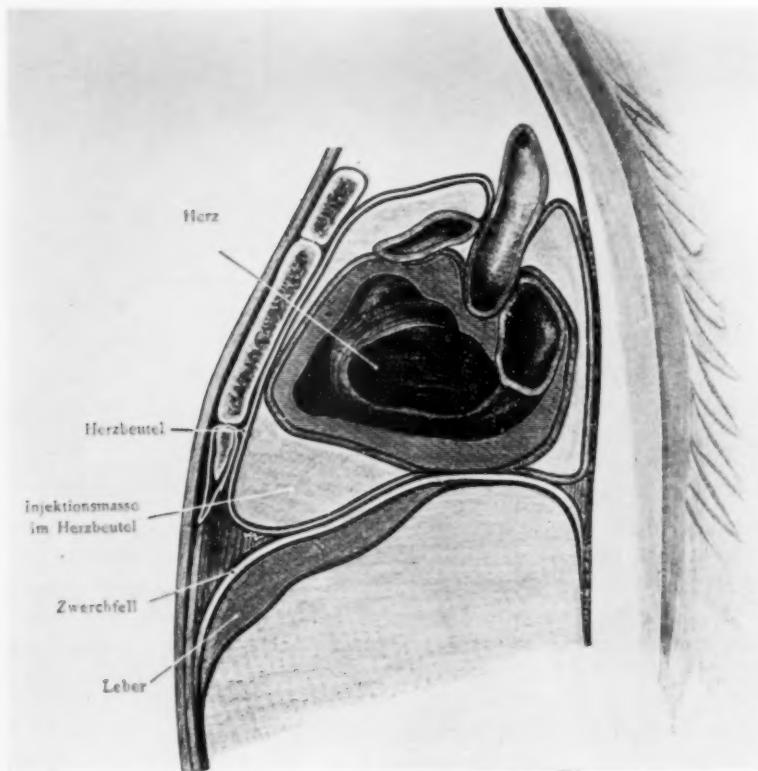


FIG. 14.—Position of exudate in distended pericardium. (Curschman.)

## PERICARDIOTOMY FOR SUPPURATIVE PERICARDITIS

and removed. The same procedure is carried out with the sixth and fifth cartilages (Fig. 16). The thin layer, including internal intercostal muscles and posterior perichondrium, is incised vertically and easily separated from the underlying tissues. This exposes the internal mammary vessels (Fig. 17). At the upper part of the wound they lie about one-half inch from sternum. They should be ligated above and below to lessen the danger of secondary hemorrhage. The thin triangularis sterni is separated from the sternum,

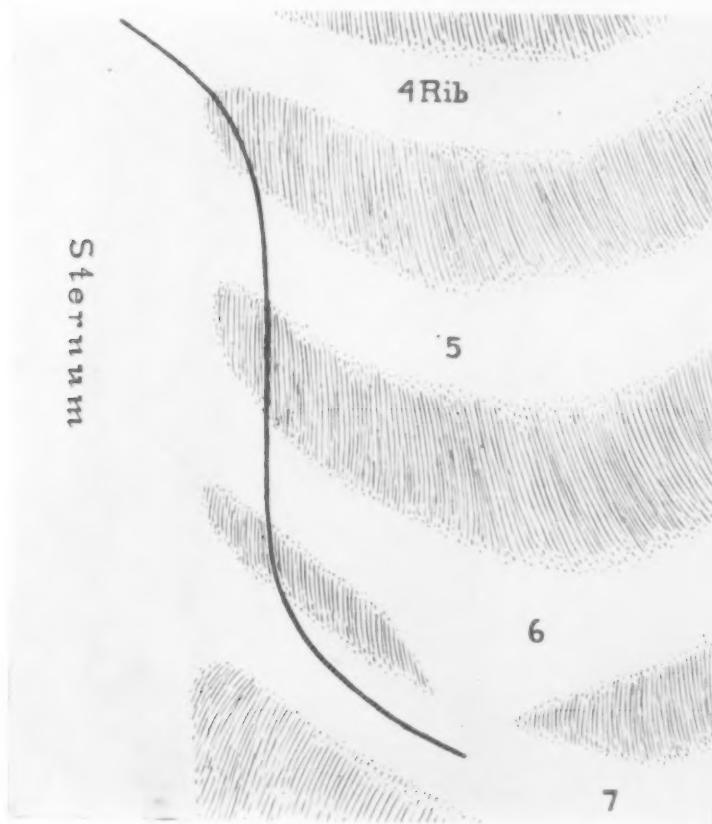


FIG. 15.—Incision for pericardiotomy.

and with finger or blunt instrument the underlying fat, and with it the edge of the pleura, is displaced outward (Fig. 18). The pericardium is thus exposed and is opened between forceps, about one centimeter from the edge of the sternum (Fig. 20). The incision should extend downward to the reflection of pericardium to the diaphragm. While the incision is in general vertical, it is advisable that it be slightly curved with concavity towards the sternum. This allows better separation of the edges and favors drainage. If possible the edges of the pericardium should be sutured to the skin or superficial soft parts to diminish the danger of mediastinitis.

Objection to removal of three cartilages may be urged on the ground that these patients are in too serious condition to warrant so extensive an operation. Yet in nine of the reported cases two cartilages were removed and eight of these cases recovered. The additional removal of a third cartilage should not be of serious import and should be more than counterbalanced by the advantages. Further objection may be raised that the operation is too extensive to be undertaken under local anæ-

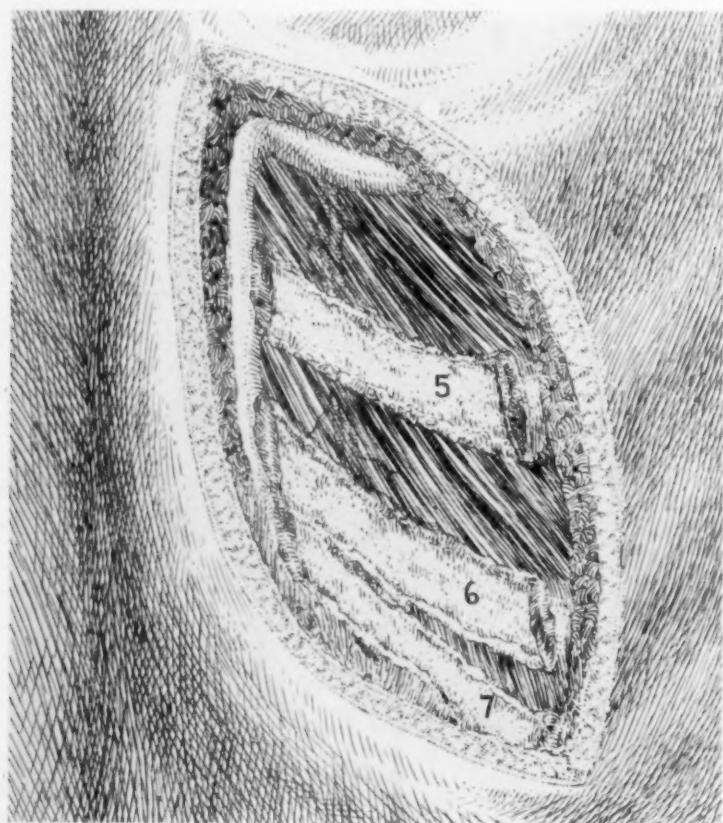


FIG. 16.—Cartilages resected, leaving posterior perichondrium and internal intercostal muscles.

thesia. This will depend upon the case and the operator. But it may be stated that general anæsthesia can be supported in a considerable proportion of cases. Of the reported operations in which a note has been found as to the type of anæsthesia twelve were general; over 50 per cent. recovered.

The question of drainage is important. In the case here reported the drain was removed in about thirty-six hours, two Carrel tubes were substituted and Dakin's solution introduced regularly. In another case I should begin the Carrel-Dakin method at once. It was here undertaken

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with some trepidation because it had apparently never been employed in the pericardium and I was uncertain as to its effects. Yet its indications seemed to demand it. On the basis of a former experience and the study of case reports, it was felt that thick pus with fibrin was likely to wall off the cavity into chambers, resulting in retained excretions and imperfect drainage, especially of the left recess. It was believed that the solvent effect of Dakin's solution would obviate this risk and would soon

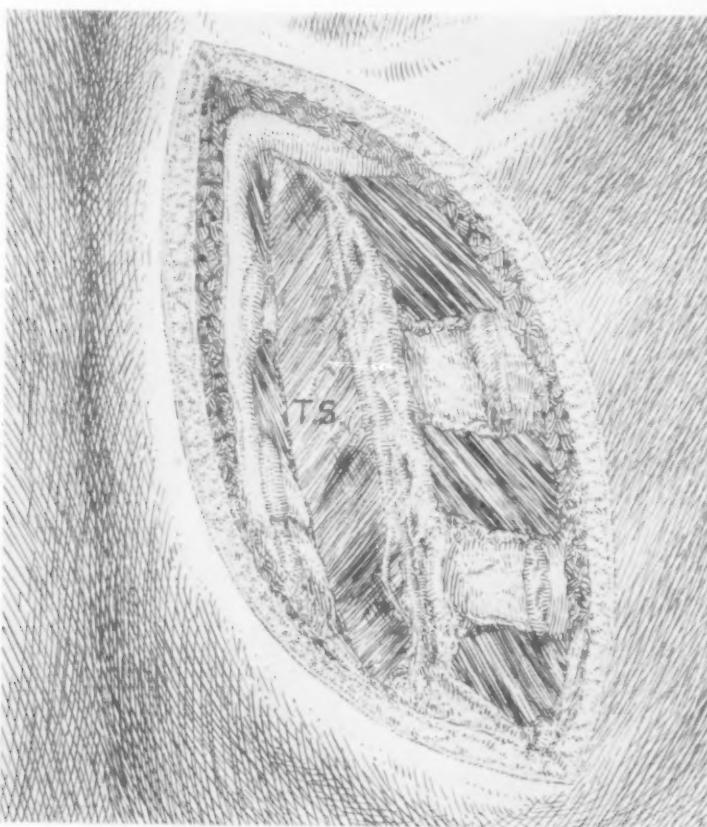


FIG. 17.—The layer including internal intercostal muscles and posterior perichondrium incised vertically, exposing internal mammary vessels. (T. S., triangularis sterni.)

render the excretions thin and less in volume, besides gradually sterilizing the cavity. Practice confirmed the theory. Improvement was striking and sustained. The solution apparently exerted no noxious influence upon the pericardium and may, I think, be employed with confidence and advantage in subsequent cases.

*Immediate Results.*—Roberts, 1897; Porter, 1900; Eliot, 1909; and Rhodes, 1915, have collected the reported cases of pericardiotomy for suppurative pericarditis. According to Rhodes, the cases numbered eighty-six, of which forty-five recovered and forty-one died, a percentage

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of 52.3 recoveries against 47.7 deaths. In the series the organism was reported in twenty-one only, the pneumococcus was found in nine cases, staphylococcus in four, streptococcus in three, a mixed infection of streptococcus and staphylococcus in two, the colon bacillus in one, the bacillus pyocyaneus in one, and a double coccus in one. The reports, however, are of very limited value for analytical study since details are often lacking. This illustrates the importance of full reports, not simply operative results, in such unusual cases.

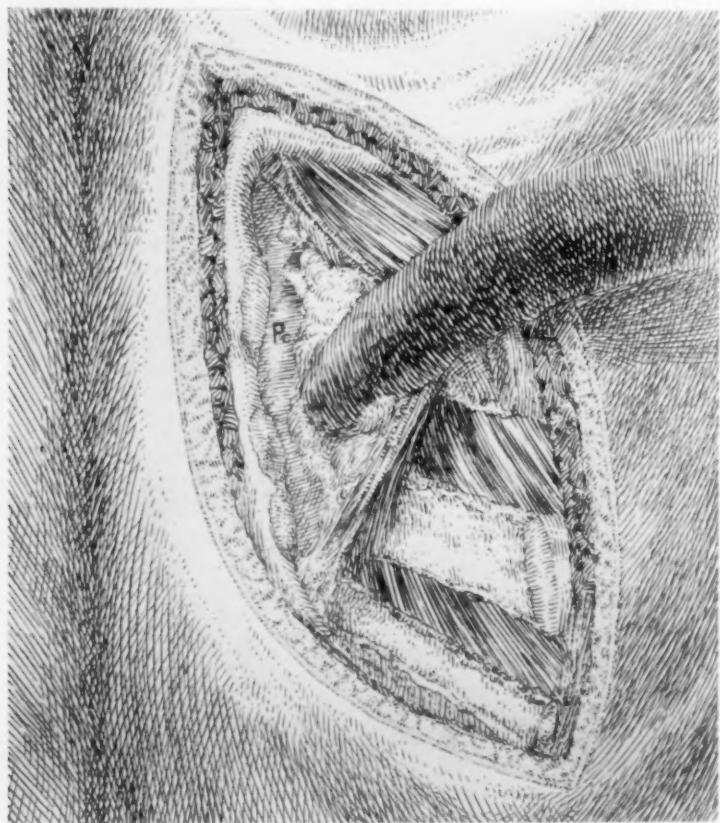


FIG. 18.—Triangularis sterni separated from sternum. Finger displacing fat and pleura outward to expose pericardium (Pc).

An effort to collect more recently reported cases has added thirteen. It is noteworthy that the six cases which followed traumatism recovered, while of the seven non-traumatic cases only two recovered. This brings the total to ninety-nine cases with fifty-three recoveries and forty-six deaths. Summaries of these cases are appended.

*Late Results.*—The ultimate prognosis in a case of adherent pericarditis depends not only upon the extent and density of the intrapericardial and mediastino-pericardial adhesions, which may restrict the cardiac

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activity, but to a large extent upon the degree of myocarditis. In suppurative pericarditis the heart substance is always involved to some extent in the inflammatory process; degenerative and fibroid changes result and if extensive lead to dilatation. Resulting circulatory disturbances are often of late development. They are evidenced, according to McPhedran, chiefly by palpitation, tumultuous heart action, dyspnoea, a tendency to syncope and cyanosis, finally signs of cardiac failure, such

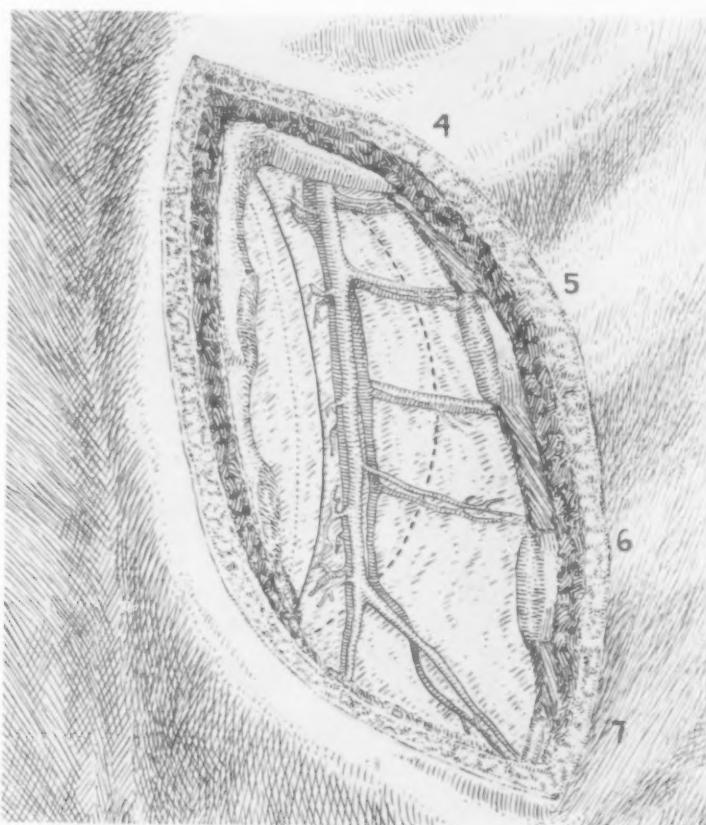


FIG. 19.—Diagrammatic: Portions of fifth, sixth and seventh cartilages removed. Approximate relations of lung, pleura and internal mammary vessels to line of incision in pericardium. - - - lung; —— pleura; . . . . line of pericardial incision.

as anasarca and ascites, may supervene. On the other hand, according to the same author, light adhesions with little myocarditis may give rise to no functional disturbance.

To what extent myocarditis and adhesions cause functional derangement in drained cases of suppurative pericarditis is not evident from clinical observation. In only a few cases are the results recorded a sufficient period after operation to be convincing. Good functional results were reported in the following: Lilienthal's case, twenty years after operation; V. Eiselberg's case (Walzel), a boy of nine, was well nine

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years after operation. Kiliani's patient, seven years; Eliot's, two years; Peters', a boy of seven, eleven months; the case here reported, eight months. Other cases, with the exception of Davis' case, are not reported later than four months. In two cases poor functional results are recorded: Davis' patient, a boy of eleven, one year after operation showed marked adhesive pericarditis; LeConte's patient (Scott), a male, aged thirty-six years, four months after operation palpitation persisted and prevented return to work.

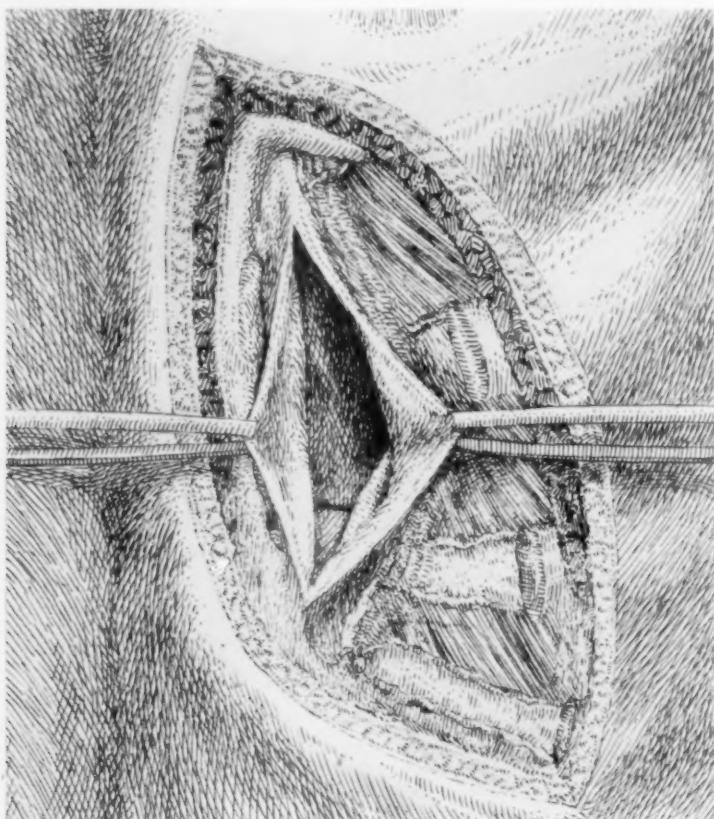


FIG. 20.—Pericardium opened, showing heart and diaphragm.

Presumably the earlier the drainage the less will be the myocardial involvement; moreover, it is possible that early treatment with Dakin's solution will diminish pericardial adhesions. Certainly the functional results will not be prejudiced by early drainage, while the immediate mortality will be reduced by timely operative intervention.

CONCLUSIONS

The method here described (resection of portions of the seventh, sixth, and fifth cartilages) meets the most important indications, namely, it opens the pericardium at its lowest part; involves little risk of injury

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to the pleura; provides ample drainage and allows such exploration as is necessary both at the time of operation and during the post-operative course. If the condition of the patient warrants it, I believe this method is advisable, especially if a brief general anaesthetic can be tolerated. In some cases, a less extensive exposure may seem imperative. Under these conditions resection of the sixth and seventh cartilages seems best. The procedure was employed in the case here reported and gave quite satisfactory exposure and provided efficient drainage. In conjunction with the Carrel-Dakin method it probably would prove adequate for many cases. Resection of the sixth cartilage alone may be done readily under local anaesthesia and is tempting by reason of its simplicity, but the drainage is not satisfactory.

The Carrel-Dakin method appears well adapted to the post-operative treatment of suppurative pericarditis.

### CASES REPORTED SINCE 1915:

BARIÉ AND LEBERT: *Bull. et Mém. Soc. Méd. Hôp. de Paris*, 1915, xxxv, 1042.

Pyopneumopericardium was observed in a man thirty-one years of age whose condition was not recognized accurately until five months after the onset of the disease, when pericardiotomy was performed.

Extremely offensive gas escaped, as well as a small quantity of offensive grayish fluid. Bacteriological examination showed staphylococci in large numbers and rod-shaped bacteria. The patient died six days after operation. Autopsy showed that the pyopneumopericardium was the result of oesophageal perforation, caused by a broken down tuberculous mediastinal gland. The oesophagus became ulcerated and then perforated, the ulcerative process extending to the pericardium, which also became perforated, with establishment of a fistula between the oesophagus and the pericardium.

BOUDIN, M.: *Presse Méd.*, Par., 1916, xxiv, 523.

Observation on a case of suppurative pericarditis caused by a small focus of superficial pulmonary gangrene, which was adherent to the pericardium and had infected the latter. The suppurative pericarditis behaved like a primary pericarditis. It was first punctured, and then treated surgically, but terminated in death.

ROBEY, W. H., JR.: *Am. Jour. Med. Sc.*, 1917, cliii, 529.

This paper is based upon a study of the protocols of eighty proved cases of acute pericarditis and the literature particularly of the preceding five years. It seeks to emphasize certain physical signs which have seemed of importance to the writer.

1. Man, aged thirty-two years. Had been ill two weeks with pneumonia, was improving, then grew worse. Diagnosis of pericarditis with effusion was confirmed by röntgen-ray examination. Needle inserted, gave 20 c.c. of sero-purulent fluid. Operation, 2 quarts of pus removed. Patient relieved, but died a few hours later.

2. Case of purulent pericarditis following pneumonia. Exploratory puncture made in fourth space to the right of sternal margin and operation followed, the fourth and fifth costal cartilages being resected. The patient made a good recovery and the discharge ceased in three weeks.

DAVIS, C. B.: Suppurative pericarditis. Demonstration of a case one year after operation. *Surgical Clinics of Chicago*, 1917, i, 375.

The patient, a boy eleven years of age, entered the hospital with multiple suppurating bone foci culminating in an attack of suppurative pericarditis. Exploratory puncture close to the sternum in the fifth intercostal space yielded pus; the fourth and fifth costal cartilages were resected for an inch and the pericardium exposed. An artery forceps was forced into the pericardial cavity by the side of the exploratory needle and a large quantity

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of pus allowed to escape slowly. A soft rubber tube was sutured in the pericardial cavity and drainage was continued for several weeks. The pericardial shadow diminished, as was shown by X-ray examinations, and the pericardial wound healed in about four weeks. Bacteriologic examination showed pure cultures of staphylococcus aureus in all lesions. One year later, physical examination showed the presence of adhesive pericarditis, the pericardium being not only adherent to the heart, but also involved in a chronic mediastinitis and fusion of the pericardium with the pleura and to the chest walls. It is stated that besides being a good example of acute suppurative pericarditis successfully treated in respect to the immediate lesion, this case illustrates the typical post-operative results showing why the ultimate prognosis is so unfavorable, especially in children.

WILLIAMSON, C. S.: *Medical Clinics of Chicago*, 1917, ii, 907.

Patient, man aged forty years, with symptoms of acute miliary tuberculosis; duration of illness, eight days, with fever, chilliness, cough, and pain in the left side. The physical signs indicated pericarditis with effusion, and the fluoroscopic findings confirmed this assumption. A purulent exudate was suspected on account of the high leucocyte count, and diagnostic aspiration of the pericardium yielded thick creamy pus, which contained the pneumococcus in pure culture. Under local anaesthesia with novocain, the cartilage of the fifth rib was removed subchondrally and pericardium opened. Sixteen ounces of thick creamy pus, shown later to contain pneumococci, was removed. On digital exploration, no adhesions or walled-off pus cavities were found. Three gutta-percha drains were placed in different parts of the pericardium, drainage remained profuse to the end, seventeen days after operation, which was followed at first by temporary improvement. The autopsy showed acute fibrinous purulent pneumococcal pericarditis and hypostatic pneumonia of the dependent portions of both lungs, besides old calcified tuberculosis of the right lung.

CAMAC AND POOL: *Amer. Jour. Med. Sciences*, 1917, cliii, 509.

Male, aged forty-seven years, pneumonia lower right base. Twelfth day thoracotomy for empyema; staphylococcus aureus. Eight days later signs of pericardial effusion. Exploratory puncture revealed purulent exudate. Pericardiotomy under local anaesthesia, excising sixth cartilage; considerable pus evacuated. Two rubber tubes for drainage. Pus showed same organism as empyema. Marked temporary improvement, but sixth day femoral phlebitis. Blood culture showed staphylococcus. On thirteenth day after pericardiotomy patient died.

GUILLERMO, M. L., AND MONTOYA, J. M.: Pericardiotomy, Suppurative Pericarditis. Pericarditis supurada y pericardotomia. Report de Med. y Cirug. Bogota, 1917, ix, 115. (Abs. *Surg., Gynec. and Obst.*, 1918, xxvii, 217.)

Boy, aged eight years. Suppurative pericarditis following injury in precordial region. Under clinical observation for some time. No improvement. Operation: Under chloroform; transverse incision about 5 cm., starting from the sternal edge along fifth costal cartilage. Pericardium exposed, opened, and a quantity of bloody fluid drawn off; cigarette drain inserted; incision partly closed. Child able to get up on twentieth day, and made a normal and complete recovery.

The following cases resulted from wounds by projectiles:

ALBRECHT, P.: *Wiener Med. Wochenschrift*, 1920, No. 1, p. 35.

Patient twenty-one years of age had been wounded in the chest by a bullet, but remained only a few days in the hospital. Soon after his discharge dyspnea and palpitation developed, suppuration in the pericardium was suspected, and pericardiotomy was done. The projectile could not be found on exploration of the pericardium, which contained much sero-purulent fluid with some fibrinous adhesions. The adhesions were detached and the wound was drained; the drainage-tube was covered with a rubber stall in order to prevent the aspiration of air. The pulse-rate dropped to about 80 soon after the operation, and the patient made a good recovery.

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JONES, L.: Gunshot wound of the pericardium and heart. Pneumohæmo-pericarditis. Operation. Recovery. *British Journal Surgery*, 1916, iv, 103.

Patient a soldier, aged thirty-eight years, who was wounded by high-explosive shell and admitted to hospital with two shell wounds of the chest-wall. The wounds were infected. Diagnosis of pericarditis was confirmed by X-ray examination. The extensive dulness was seen to be sharply localized and due to an extensive pericardial effusion. Operation under ether anaesthesia. Incision following the border of the seventh costal cartilage and the middle of the sternum; portions of the seventh, sixth and fifth costal cartilages and half the width of the sternum were removed; the pericardium was incised vertically for two inches. A large quantity of foul-smelling gas, and offensive fluid measuring 22 ounces escaped. The foreign body was not in the pericardium. A flanged rubber drain introduced into the pericardial sac. Part of the wound sutured. Iodine solution was used for flushing the pericardial cavity until the wound had entirely healed, which occurred in seven weeks. Electrocardiograph examination three and a half months later showed no evidence of hypertrophy or dilatation. No murmurs were heard; none of the cardinal signs of adherent pericardium were observed. An X-ray plate showed that there was no increase in the size of the heart. Patient in good condition.

KLOSE, H.: Ueber eitrige Pericarditis nach Brustschüssen und pluerale Pericardiotomie. *Beiträge zur klin. Chirurgie*, 1916, ciii, Kriegschirurg Heft, vi, p. 556. Medical supplement, *Daily Review of the Foreign Press*, 1918, i, 53.

The author reports four cases of suppurative pericarditis following bullet wounds of the chest. Three died, and one recovered after extrapleural pericardiotomy under local anaesthesia by Rehn's costo-xiphoid incision.

CRABTREE: *Med. Press*, London, 1919, n. s., cvii, 472. A Case of Successful Operation for Wound of the Heart.

Soldier, struck in chest by spent bullet, November 8, 1918; admitted to No. 22 General Hospital on November 9th. Entrance wound two and one-half inches to the left of sternum between fourth and fifth ribs; slight purulent discharge; pericardial friction over whole cardiac area; no evidence of fluid; chest clear. X-ray examination showed bullet in heart shadow. Bullet moved with heart's impulse. In view of extreme pain and infected pericardium operation was determined upon.

November 13th. Eight-inch incision made to the left of sternum, curving outward along the sixth rib. Fourth and fifth costal cartilages and one inch of each of corresponding ribs resected. One-half inch of left margin of sternum was removed. Pericardium was opened by a T-shaped incision to give access to extreme left side of heart. Considerable thin pus escaped. Area of fibrin and adhesions was found between the visceral and parietal pericardium on the extreme left surface of heart near the junction of the left auricle and ventricle. The bullet was found to lie tangentially to the cavity of the heart, buried in the heart muscle, but had not penetrated cavity. Owing to sepsis, the wound in the heart was not sutured after the removal of the bullet. The incision in the pericardium was loosely sutured about the rubber tissue drain. Muscle and skin flaps were sutured into place. Recovery was uneventful, save for the collapsed left lung. March 13, 1919, patient was well.

The report states that this was the twelfth case of heart injury in the British Army to be operated upon, and was one of the four recoveries.

NOBLE, T. P., AND VINE, A. B.: Note on a Case of Pericardiotomy. *Lancet*, London, 1919, i, 107.

Soldier. Pericardiotomy performed on twelfth day after passage of rifle bullet through chest, with recovery of patient.

Wounded April 11, 1918. Bullet entered in the third interspace, one-half inch internal to nipple line on the left side, exit one and one-half inches to the left of midline behind, on a level with seventh dorsal spine. Apparently punctured pericardium and grooved muscular wall of heart. April 21st, symptoms bad; X-ray confirmed pericardium distended with fluid.

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*Operation.*—General anaesthesia with chloroform and ether. Incision along fifth rib and cartilage from midline to nipple line, fifth costal cartilage resected, vertical incision in pericardium; finger insinuated between right auricle and pericardium and left ventricle and pericardium; escape of quantity of cloudy fluid, which was found to contain a short streptococcus. Glove drains inserted to the right and left inside the pericardium, wound closed; drains removed two days later, wound healed by first intention. Recovery in four weeks, and improvement maintained two months later.

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## DIAPHRAGMATIC HERNIA

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AND

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TRAUMATIC diaphragmatic hernia has been shown to be not as infrequent in the adult, as was previously thought. Such hernias have often been reported during the great European war as arising from gunshot, bullet, shell and stab wounds of the diaphragm. Still the clinical diagnosis is no clearer than it was heretofore. Congenital hernias of this sort are quite infrequent in the adult, and it is for this reason that this case is presented as for the fact that this condition may be mistaken for very much more frequent conditions and so a fatal error in treatment be made.

The patient was a widow, aged sixty-five years. Her chief complaint was discomfort in the left chest and dyspnea.

Her symptoms date back many years. The patient cannot furnish any history of a sudden onset nor of a time when she was entirely free from symptoms, nor can she furnish any history of a trauma of such a nature as might be capable of resulting in such a hernia. She has some sort of discomfort on her left side which is relieved by belching, which she does often, and which has no relationship to meals. She describes cramps of an indefinite nature beneath the costal margin on the left side, and also complains of occasional sticking pains in the left chest. She is markedly dyspneic, particularly so on exertion and has been so for the past ten years. For the same period of time she has had some gravitation edema after walking. She has attacks of palpitation occasionally. Her upper and lower extremities are always cold, particularly in the morning. She suffers with some dizziness and has a poor appetite. Despite all this she was able to gain weight after a rest in the "country." Her habits are good. She drinks tea and coffee in moderation. She has a marked polyuria both day and night.

*Physical Examination.*—When admitted there was marked visible pulsation in the neck on both sides, but more marked on the right. There was also a fullness of the lateral part of the neck on the left side, which is not accounted for by enlarged cervical glands or a large lateral lobe of the thyroid gland. The antero-posterior diameter of her chest was markedly increased. By measurement the right side of her chest was markedly larger than the left. The angle of Ludovici is very prominent. The left infra- and supraclavicular depressions are more marked than the right. The pulsation in the right supraclavicular fossa is more marked than the left.

On palpation cardiac pulsation is felt antero-laterally on the right

side and not at all on the left. There is no bronchial fremitus felt on either side. Vocal fremitus is felt on the entire right side with the exception of the heart area. On the left side it is absent with the exception of a small area in the suprascapular region above the spine of the scapula. There is no expansion of the left chest either visible or palpable. The right expands normally.

The *percussion* note anteriorly in the left suprACLAVICULAR space has a peculiar mixed emphysematous and tympanitic quality. Below this the note becomes more tympanitic and is almost skodaic in the second intercostal space. The note then becomes absolutely flat to the base. On the right side, anteriorly, the note is emphysematous throughout with the exception of the cardiac dulness which will be described later.

Posteriorly the right side gives an emphysematous note throughout. The left side gives a similar note to the inferior angle of the scapula. Below this it is flat to the base. In the axilla on the left side the emphysematous note extends to the seventh rib and then becomes tympanitic, as if the stomach lay high.

On *auscultation* anteriorly the breath sounds are heard down to the second rib on the left side and not at all below this. Posteriorly the breath sounds on the left side are heard only a little at the apex and slightly along the vertebral column for a short distance.

On the right side the breath sounds are accentuated as in compensatory emphysema. They are absent over the area occupied by the heart on the right side. Over the right base posteriorly and laterally are heard a few crackling râles.

The voice sounds are normal on the right side, front and back. On the left side anteriorly they are heard to the second intercostal space and posteriorly as far down as the spine of the scapula.

*Heart*.—There is visible pulsation in the fourth intercostal space on the right side in the midclavicular line. The apex beat apparently is felt in the fourth intercostal space 11 cm. from the midsternal line on the right side, a little to the right of the midclavicular line. Cardiac dulness percusses to the anterior axillary line on the right side. No heart sounds are heard on the left side. On the right side no abnormal sounds are heard. The second sound over the normal aortic area is accentuated.

The *blood-pressure* was 150 mm. systolic and 100 mm. diastolic on the left side and 164 mm. systolic and 100 mm. diastolic on the right side, a difference of 14 mm. mercury favoring the right side.

The *coin test* was positive on the left side. There was no *succussion*.

The *abdomen* was flabby throughout. The liver and spleen were not felt. There were no masses felt. All the *reflexes* were normal.

The *röntgenological examination* showed the heart to be on the right side. The right lung was well aerated. On the left side lung tissue was confined to the extreme upper part of the left chest and was separated from an abnormal area by a linear dense shadow made up of the dense fibrous, almost calcified lining of the cavity

## DIAPHRAGMATIC HERNIA

containing the hernia. Below this could be made out some coils of intestine and the fundus of the stomach which lay above a distinct linear shadow of the diaphragm which seemed to lie a little higher than that on the right side. It was impossible to get a gastrointestinal series of pictures because the patient refused the bismuth meal.

*Discussion.*—There is perhaps no condition that is so difficult of recognition clinically as diaphragmatic hernia. Here we have an adult that upon first examination would seem to have a collection of fluid in the left chest. The variability, however, in the signs in front and behind led us to have an X-ray taken, and this revealed the condition.

If there is anything of more interest in this case than anything else, it is the fact that a patient with a very large diaphragmatic hernia can get about with comparative comfort and successfully pass through two attacks of what is evidently a respiratory infectious disease, influenza. It seems that this in itself should lead not only to greater care in physical examination and the more frequent use of the Röntgen-ray in chest work, but above all to the idea that many of these cases may be left alone, for the operation is one of considerable difficulty and should be performed only in emergency, *i.e.*, when there is evidence of intestinal obstruction. This case also lends support to the probability of the more frequent occurrence of diaphragmatic hernia in even the presumably healthy, for such can give not only very variable signs and symptoms, but often no signs or symptoms at all, as, for instance, the absence of physical signs in the left axillary region in this case.

As far as clinical diagnosis is concerned, we think there is nothing of such great significance as the variability in signs in various parts of the same side. The presence of air as evidenced by the coin test, if present, is a valuable aid. Of course there is nothing like the X-ray, but one must be led to this by the physical findings and the tentative clinical diagnosis.

## THE PRESENT STATUS OF GASTRIC AND DUODENAL ULCER

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FOR practical purposes chronic (sometimes called "peptic") ulcers of the stomach and duodenum conform themselves to one of two types: The first of these—and, perhaps, the less important—are the soft lesions characterized (1) by their relatively smaller size, (2) by their superficial extent, (3) by the failure of the process to penetrate any deeper than the submucosa, (4) by the absence of surrounding areas of induration; noted (5) by the frequently greater benignity of the clinical course, (6) by the tendency not to undergo malignant transformation, (7) by the frequency with which cures are obtained with medical means alone. The second are the lesions characterized (1) by their comparatively larger size, by their deep penetration and frequent perforation, (2) by their marked induration and by their numerous and dense adhesions to surrounding organs, especially to the pancreas; (3) by their marked chronicity and frequent "relapses"; noted (4) by the frequency with which malignant changes are found throughout the lesion or limited to its bed or margin; (5) by the tendency to complications of a mechanical nature accompanying their progression. There are cases, however, in which the characteristics of the one overlap into that of the other, or in which a proper distinction of the lesion is made difficult or impossible because of many associated phenomena frequently of a functional nature.

In any case the trend of our knowledge is towards the assumption of the theory that defects in the gastric or duodenal wall, quickly forming or slowly forming, appear frequently and because of more than one cause, and that the opposing forces in the gastric or duodenal physiology are so accurately balanced as to assure under ordinary circumstances an extraordinarily rapid healing. In a number—of which the relative percentage is not known—the healing is prevented by some factor which, up to the present, has remained undiscovered. It is quite possible and probable that this unknown factor may of itself be one of the agents capable of producing the original defect, in which case the continuance of its presence prevents the natural healing, or it may have become secondarily superimposed upon the original circumstance which had yielded or permitted the primary lesion.

The old conception that a typical history indicates absolutely the presence of an ulcerative lesion in the stomach or duodenal wall seems to have been generally abandoned. It is quite true that many times the operative exploration fails to reveal the presence of any ulcer; but it is equally true that just as often a rather indefinite or trivial history is

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proved to be due to very large lesions in the wall of the stomach or duodenum. Experimentally it is rather well known that defects in these organs can be produced in very many different ways and repeatedly in the same animal and that all of these artificially made lesions have the marked tendency to heal very promptly and rapidly. It does not seem unreasonable to assume that in human pathology there are numerous occasions when temporary defects of relatively similar origin and nature appear in the stomach and duodenum and that these, too, should have the characteristic of healing quickly. Unless these would be looked for within a reasonably short space of time the likelihood is very strong that they could not and would not be demonstrable on the operating table. Yet such lesions would give symptoms; and there is no reason why the symptomatology should not be as typical as any described. It is conceivable, therefore, that the original viewpoint of Moynihan and others may have some basis of truth; namely, that a typical history always spells an ulcerating lesion, with the distinct proviso, however, that a great many of these undergo rapid and spontaneous healing. If placed under treatment recovery would follow with complete disappearance of the symptoms and the effect might be a permanent one. I am quite sure that many of the "medical ulcers" are of this type. If for any reason new ulcers developed subsequently, the symptoms would reappear and, as healing again took place, these would disappear once more. A great many of the remissions seem to be explainable on this basis.

I have the impression that lesions of this kind are comparatively small and are frequently in the duodenum—perhaps somewhat more frequently there than in the stomach. They are the kind which give little or no positive evidence of ulcer objectively, especially with the Röntgen-ray. They are the kind which give most of the medical cures and for which surgery of any kind is not indicated and may even be harmful.

There is no positive evidence to prove either that the large indurated ulcers have their beginnings in acute defects which originally have the tendency to heal, or that they begin as indurated lesions and continue so. Clinically periods of remissions have been noted with indurated lesions also; and when the latter are demonstrated on the operating table, the history of remissions of symptoms make it open to serious consideration whether, originally, acute healable defects had been present which, having healed and recurred, have later been transformed into the indurated type of ulcer. I believe that when once the indurated lesion has become well established there is little or no remission in the symptoms and that the latter, as well as the actual pathological process, become progressive.

The diagnosis of ulcerative lesions of the stomach and duodenum has been difficult; it requires time, study, patience and a careful checking up by the various laboratory data. The elicitable symptomatology can be grouped accordingly as it is referable (1) to pain, (2) to disturbed gastric

function, (3) to disturbances in other organs, (4) to hemorrhage, (5) to perforation, and (6) to resulting anatomical deformities of the stomach. The Röntgen-ray is of tremendous importance in making the diagnosis; with the passage of time and the accumulation of much experience it has succeeded in establishing for itself a most dominant position; so much is this so that very frequently now the other factors serve but to attract one's attention to the stomach or duodenum as the organ which is at fault. When the Röntgen-ray demonstrates the presence of a distinct penetration all other evidence of a diagnostic nature fades into obscurity because of its comparative inutility. When no such positive evidence is demonstrable in the fluoroscopic examination the method, in the very best hands, furnishes still the very best and most satisfactory corroborative evidence of the presence of a gastric or duodenal lesion; under these latter conditions, however, the Röntgen-ray evidence is not infallible. This is especially so with the duodenal cases, and frequently the operation must necessarily assume the characteristics of an abdominal exploration.

Estimations of the functional capacity of the stomach—that is, of the chemical and motor activities—have virtually lost all of their importance as diagnostic aids. The danger here lies in the fact that the delegation and submergence of these elicitable data to very unimportant positions in the diagnosis may be so complete as to result in their being dispensed with altogether for any purpose whatsoever. The information derived from these sources, however, is really of great importance and should be carefully determined in each individual case. With the exception of pain, almost the entire symptomatology is due to disturbances of physiology both in the secretory and in the motor function, and the satisfactory explanation of the coarser and finer differences in each individual case is frequently only determinable upon the variations of the several functions from their established normal. Estimations of the variations in function can be determined quantitatively. As pointed out in a previous communication, the determination of the beneficial effect of any operation or line of medical treatment and of the subsequent improvement in function—which frequently, but not always, goes hand in hand with any improvement in the symptomatology—is also measurable and comparable in the subsequently repeated estimations of function; and, when in the post-operative course prolongation of or renewal of symptoms occurs, it is possible frequently and similarly to interpret the latter in the light of any associated disturbances of function.

In the actual gastric pathology disturbances of the chemical function play a less important rôle. Digestion of the food can be very adequately done in the small intestine, and the chief duty of the stomach is to prepare the food for its further intestinal digestion. Disturbances of gastric chemism resulting in an inadequate preparation of food can be and frequently are, therefore, reflected in intestinal symptoms.

Much the more important rôle belongs to the motor function. If the

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stomach be properly emptied in a normal interval—with due regard to the character, composition and preparation of the food intake—the disturbance resulting from any associated variation from the normal of the chemical function, while distinguishable to any observer, gives such little perceptible evidence and is so easily tolerable to the patient as to readily escape notice. Evidence of disturbance of the motor function is, however, immediately productive of symptoms. The more common derangement, that is observed, is a retardation of the passage of food and a lengthening of the total emptying time of the stomach. When associated with ulcer the interference with the muscular activity may result from an organic obstruction at the pylorus serving to nullify a primary exhibition of increased muscular effort, or it may be a reflex phenomenon associated with the presence of a lesion in the body of the stomach, usually on the lesser curvature and posterior wall, which from its very onset is a progressive decrease of muscular effort combined with pylorospasm; in either case the extreme end-result is a paralytic atony of the stomach musculature. With ulcerative lesions both of these varieties occur in about equal proportions.

In ulcer cases the extreme condition mentioned—tony—should receive the most careful attention both before and after operation. The importance of the observation lies in the fact that in the more advanced cases the condition is beyond recovery; operation is then not followed by the improvement in symptoms which had been anticipated, even though the offending pathology has been entirely removed and the mechanical conditions for drainage have been enormously improved by the operation; symptoms are many and distressing; and treatment is very difficult if not impossible. In the more fortunate cases the atony is still in condition for recuperation to take place: this may be a very rapid process and then the success of the operation from the symptomatic point of view is all that is to be desired and is very prompt; in others the recovery of the normal tone and function is more slowly accomplished, and for these patients the services of the expert medical man are most necessary and desirable, especially in the immediate post-operative period and until full functional recovery is reached.

In many patients—though not occurring as often as the derangement previously described—the disturbance in muscle function is not a retardation but an acceleration of activity leading to the emptying of the stomach much before the normal emptying time. This disturbance is not as frequently noted before operation as it is afterwards. Then the mass of stomach contents is hurriedly emptied into the duodenum and jejunum in a state of insufficient preparation, because of which an irritant effect is exercised upon the intestine. The duodenum and jejunum become unduly distended and overdistended by the unexpected mass of stomach contents; in the effort to rid itself of this unwelcome burden peristalsis is enormously increased and the intestinal contents hurriedly passed on.

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The effect has certain similarities to that obtained when the chemical functions are at fault; the similarity is quite true, for in both the disturbance is a quantitative one. Of the two—retardation and acceleration—the latter, perhaps, is capable of creating more harmful effects and more distressing symptoms; the commonest symptoms include diarrhoea and loss of weight.

With the means at present at our command it is not possible to make out any relation between the position, the character, the extent, the degree and severity of the symptoms complained of and the size, location, depth of the ulcer, or the presence or absence of associated or consequent anatomical complications. The character of the functional disturbances seems also to have no mathematical relationship to the lesion present. No correlation can, therefore, be made between the clinical picture with its varied symptomatology and laboratory findings which the individual case presents and the lesion which is present and which one is about to treat. No prognosis can be made of the rapidity with which the lesion will yield to treatment nor of the character of the post-operative course if operation be undertaken. This state of affairs is probably due to the presence of associated factors about which we have no, or very little, knowledge and which probably exercise important functions in determining the character of the clinical picture.

There is reason to believe that some, if not many or all, of the individual functions of gastric physiology are controlled by the internal secretions either alone or in conjunction with nervous impulses. The physiological purpose is attained by the orderly working of all of the various forces indicated, and it is perfectly reasonable to assume that in an unknown number of cases disturbances of stomach functions—hyperacidity or hypoacidity, or atony or hypermotility of the musculature—are concrete perceptible reflections of abnormalities in the endocrine organs. Such a theory explains many things in functional and organic disease of the stomach; it helps to clear up the etiology of hyperacidity, hypoacidity and anacidity which have no apparent anatomical basis, and gives a cause for an hitherto unexplained hypermotility or atony of the musculature; and when an anatomical lesion, such as an ulcer, is demonstrable, it helps to make clear the mechanism whereby the organic lesion causes the accompanying disturbances in secretory and motor function. The apparent discrepancies between anatomical lesion and symptomatology and laboratory data indicated previously are probably explainable on this basis.

Hæmatemesis has always been an important symptom and factor in the clinical complex of ulcer. Frequently it is the only symptom. It is well to remember that, as a symptom, hemorrhage from the stomach or duodenal wall with, or without, the vomiting of blood, marks a large number of clinical pictures of which the well-known lesions of ulcer form only a part. Other causes for this phenomenon include the lesions of

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tuberculosis and syphilis, and benign and malignant tumors as well as those in which recognizable lesions are present in the liver, or in the spleen, or in both of these organs. Gastric hemorrhage is also known to occur during some of the infectious diseases, such as pneumonia or typhoid; and as a result of certain infective foci situated in other abdominal viscera, notably the appendix. Finally, there is the group of "gastostasis" cases (Hale White).

Penetration of the lesion occurring through the base of an old established ulcer and when the nourishment of the patient is approximately at par results from the gradual progression of the pathological process and is invariably accompanied by the formation of protecting adhesions around the lesion on the peritoneal side of the stomach wall, which effectually lead to a safe walling off of the base of the ulcer and to the prevention of any sudden outpouring of gastric contents into the free peritoneal cavity. There have been numerous experiences during the course of chronic ulcers in which the patient gave sufficient general and local evidence of this emergency to ensure the accuracy of the diagnosis; the symptoms subsided very quickly, however, and thereafter the course of affairs was not different from that previously experienced by the patient; in a number the assumption was confirmed by operation undertaken a few days subsequently.

A sudden perforation into the free peritoneal cavity through the base of an old ulcer under the conditions just described is indicative of a lack of healing power on the part of the individual. The mechanism, in some of the cases of this kind, may, however, be independent of the healing powers of the individual, and is similar to that which causes the occurrence of acute perforations in the absence of any preexisting perforative lesion. Here it assumes the characteristics of an embolic phenomenon occurring during the course of some temporary bacteriæmia, the evidence of which may be so transitory as to be undemonstrable. There is much evidence in the fields of experimental and in that of clinical medicine which makes this assumption highly probable. Experimental evidence in which resulting necrotic areas occur simultaneously in various parts of the alimentary canal, notably in the appendix and in the stomach, goes to show that under these conditions (that is, in the absence of any preexisting ulcer) the mechanism of an acute perforating appendicitis and of a stomach or duodenal perforation are essentially the same. The subsequent histories of these cases give valuable corroborative evidence. In those of the stomach or duodenal perforation cases in which the emergency is not fatal and recovery follows operation, and in which only a suture of the perforation has been made and no complicating factor—especially a gastroenterostomy—has been added, it is the rule for the recovery to be permanent and for no post-operative symptoms to make their appearance. In this regard the accident of a perforation in the stomach or duodenal wall is exactly similar to that of a perforation of the

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appendix. The exceptions to this rule, which, probably, are quite constantly occurring, are due to the prevention of the healing of the defect, produced by the perforation, by the superimposition of that unknown factor causing unhealable chronic ulcers as indicated in the early part of this communication.

This conception of the mechanism causing acute perforation of the stomach or duodenum furnishes a plausible explanation for the frequently heard statement that perforation of an ulcer often results in its healing. This statement is both true and not true; true in so far as it applies to acute perforations of the embolic type occurring in a previously healthy stomach or duodenal wall; not true in so far as it applies to acute perforations occurring through the base of an old established ulcer. The persistence of symptoms subsequently to perforation indicates the presence of the latter state of affairs.

For a number of years American opinion in regard to the relationship of ulcer and carcinoma of the stomach has been influenced by reports from certain quarters that ulcer precedes carcinoma in a rather large number of cases. Originally the figures were put very high, almost three-fourths; latterly the percentage relationship has shown a decrease. In other quarters, especially among men who were more inclined to look upon the lesion from a purely pathological standpoint, the opinion tended to the opposite, did not recognize such a large percentage relationship, assumed that the carcinoma had preexisted in the largest number of the cases and that the ulcerating defect was a secondary phenomenon unrelated in its formation to the mechanism of a benign lesion and was due directly to the varying amount of necrosis which so frequently takes place in any new growth. Among the latter group of men it is estimated that this biological sequence (ulcer to carcinoma) does not occur in more than 2 or 3 per cent. of the cases.

A broad the opinion has always and most commonly agreed with the latter point of view; perhaps this is so because in European centres opinion is usually decided upon pathological evidence obtained in the post-mortem room. Another source of confusion has always been the difficulty of distinguishing properly between true cancerous tissue and the many forms of atypical proliferation resulting in most peculiar morphologies in regenerating gastric glands; there is no means at the present writing which enables a proper interpretation of the latter except by their ultimate outcome.

Some points of analogy in regard to this relationship can be drawn from similar lesions in the duodenum. It is possible to find but few reports in the literature of cases of carcinoma of the duodenum located exactly in the most frequent ulcer-bearing area, *i.e.*, within the first one and a half inches of the duodenum. Lichty pointed out that, although cancer of the duodenum was first described in 1746, comparatively few cancerous lesions have been found and described since. Ulcer of the

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duodenum is, however, an extremely common lesion. The mechanism of ulcer formation in the duodenum is of a similar order to that of the stomach, and the comparative rarity of cancer of the duodenum speaks volumes as regards the relationship to the latter of any preexisting ulcer when compared with similar relationships in the stomach; the inference is obvious.

As the cases are met on the operating table the difficulty, in practical surgery, always arises with the large crateriform, penetrating and perforating lesions on the lesser curvature and posterior; the difficulty is one of interpretation of the anatomical lesion from its gross appearances. The markings of such lesions, visible to the naked eye, frequently do not betray their microscopical structure. The truth is that many of the lesions show every characteristic in their gross appearance of a benign lesion and their malignancy is only apparent under the microscope. The important point to remember is that, in actual practice, it is much better and safer to regard every one of these lesions as potentially malignant growths until their true nature is demonstrated conclusively under the microscope. About 18 per cent. of ulcer-like lesions are carcinomata.

The rational treatment of ulcer is a very difficult matter and should be determined for the most part upon the anatomical characteristics of the lesion present. When the evidence is essentially indirect and more or less of a presumptive nature there is room for a difference of opinion as to the proper therapeutic course to pursue. When the evidence, however, is direct and conclusive there is no room for argument, and there is only one rational course to pursue; these latter lesions are those which can be definitely demonstrated as perceptible defects in the röntgenographic examinations.

The general opinion that the great majority of gastric and duodenal ulcers can be cured by medical means alone and can be kept cured under proper after-treatment is susceptible to some modification and is properly applicable to cases in the first group only—that is, the soft ulcers. The further opinion that most medical men push the matter of medical therapy too far and that an ulcer persisting after proper medical treatment becomes a surgical malady is one which necessarily must also be modified in view of the newer knowledge regarding ulcer and its manifestations and complications. In the cases in the first group mentioned, I believe that when there are no complicating factors present in addition to the general and ordinary manifestations of ulcer—and by this I mean especially when there is no evidence pointing to a distinct retardation of the emptying power of the stomach—medical treatment should be persisted in alone. When stasis in the stomach is well established and the drainage of the organ is unsatisfactory, then surgery is indicated without any unnecessary waste of time to restore the emptying power of the stomach to its normal condition; the important point to remember, and one which I shall refer to again, is that the surgical means em-

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ployed to secure this improvement in drainage should be one which will not disturb the anatomical arrangements and relationships of the stomach, or if it necessarily must do so, that the procedure be done in such manner as to permit at some subsequent time, if it prove necessary, the restitution of the organs to their normal status; this refers especially to the operation of gastroenterostomy.

The appearance of certain other complications also indicate the necessity for surgical interference: these are (1) repeated hemorrhages and (2) cicatricial deformity of the stomach either at its outlet (pyloric stenosis) or in its body (hour-glass deformity).

When a large crateriform lesion is demonstrated by the Röntgen-ray surgery is absolutely essential because of the following considerations: (1) the knowledge that such lesions practically never heal spontaneously;\* (2) the danger (18 per cent.) of malignancy; (3) to prevent deformity of the stomach; and (4) to prevent any irreparable damage to the functions of the stomach both on the motor and chemical sides.

One seems to be passing through a transition stage in so far as the treatment of chronic ulcer concerns us. In the beginning gastroenterostomy was deemed sufficient, and it was not until some time had passed and, more and more, the inefficiencies of the method of operating were brought home to us, that new methods, or rather new additions to the old method of gastroenterostomy, were diligently looked for and devised in the hope of securing a reliable means of curing ulcerative conditions. A great deal has been attributed to the method of making the anastomosis—to the relative point of the stomach at which the implantation of the jejunum is made, to the direction of the loop, to the size and direction of the stoma, to the kind of suture material used, and to the skill with which the necessary manipulations are carried out. Much of this seems quite true, as the records of any large hospital will show, and numerous sequelæ, which follow after operation, are undoubtedly consequences of the manner and method by which the stoma is made. But, unfortunately, this is so in a very small minority; and experience has multiplied the cases in which recurrences of symptoms, or lesions, follow operations concerning any part of which no criticism is permissible.

There does not seem to be any accurate knowledge of the exact factor in the functioning of a gastroenterostomy which exerts the beneficial effect, which is said to follow, and which assures the healing of the ulcer. Opinions have, and do still, differ and vary from the belief that the desirable effect is purely mechanical in helping to empty the stomach in a shorter than normal interval, or, at least, in side-tracking the food away from the ulcerated area, to the more prevalent interpretation that the good effect resides in the continued partial, or complete, neutralization of the hyperacid condition of the gastric contents. In the absence of definitely proved data of the actual factors causing the so-called good

\* At the most the number of these lesions that heal are very, very few.

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effect, theories as to why the gastroenterostomy is followed by many recurrences, both of symptoms and lesions, seem to be based on insecure foundations, and no criteria are available upon which one can accurately base the modifications with which one seeks to improve the results of gastroenterostomy, or upon which one can construct more reliable methods of operative, or other, treatment.

It is difficult to understand in any individual case the relation of the post-operative clinical facts to the laboratory examinations, for it is found that subjective cures may be obtained when the laboratory examinations indicate a disturbed physiology, and post-operative symptoms may appear when the functions seem to be improving or when they are within normal limits. The following facts are, however, worthy of consideration: (1) The symptoms need not necessarily be due to the disturbances of function. (2) The symptom may be pain. (3) The ante-operative symptoms and complaints and disturbances of function may have been so marked that the immediate relief obtained by operation, even if it be only temporary, overshadows completely any residue of the subjective complaints or objective findings which may persist, or any new manifestation which may subsequently appear.

The practical failure of the various modifications to which gastroenterostomy has been subjected in the hope of making it reliable, are directly attributable to this state of affairs. For a while it seemed that unilateral exclusion of the pylorus was the wanted addition; but experience has shown that the various methods of occlusion proposed and practised, either do not exclude, or when they do, become associated with new conditions which are very frequently liable to cause disturbances distressing to the patient both from their own manifestations and from the added impediment, which they furnish, if the gastroenterostomy should, for some reason, contract to too small a calibre for the adequate emptying of the stomach.

In recent years the dissatisfaction with these measures has caused a diametrically opposite swing of opinion, and "radical" operations are, more and more, being talked of which, essentially, include direct attacks on the lesion itself by a thorough removal of the ulcer-bearing area either by local excision of the stomach or duodenal wall, or by a "block" resection of the pyloric end of the stomach. With increased practice and experience the relatively large mortality, which had, at first, followed these radical operations, has been reduced, and while it is still larger than that which follows a simple gastroenterostomy, the added danger has seemed justifiable of acceptance by the more experienced men because of the greater reliability of the more permanent result, because of the obviation of certain annoying and dangerous complications, such as hemorrhage, and because of the prevention of the possibility of the retention of any carcinomatous structure.

The methods of excision, more in detail, are, in general, one of three:

(1) The local area surrounding and containing the lesion is removed by knife or cautery and the resulting defect is closed in such a way as to obviate, if possible, any resultant deformity of the stomach. Anywhere in the stomach the procedure is very easily done, but it is usually found that sufficient disturbance of gastric motor function results as to cause considerable distress to the patient. These annoyances can be almost entirely removed by doing gastroenterostomy; and the general practice, now-a-days, is to do both of these procedures simultaneously. (2) Lesions near, or at, the middle segment of the stomach, especially those on the lesser curvature and posterior wall, lend themselves quite readily to a sleeve resection, and the functional results are quite superior to those following a V-shaped resection of the ulcer-bearing area; so much so, that no further operation is necessary despite the fact that considerable deformation of the stomach follows this type of operation. The method has, however, never become very popular. (3) The third method includes the various forms of stomach resection—pylorectomy or partial gastrectomy after the essential types described by Billroth and Polya—these operations seem to yield the best results. In the duodenum excision of the ulcer-bearing area is, under certain conditions (*i.e.*, lesion located on the posterior wall near the papilla), not so readily accomplished; and when it can be done, plastic operations of the nature of Finney's pyloroplasty, or gastroenterostomy, are necessary to overcome the artificial narrowing of the lumen.

None of these various methods are ideal, however, and numerous recurrences of symptoms testify amply to the fact that the last word has not been said in the treatment of this malady, and account for the diligent efforts which are everywhere being made to improve the surgical method of therapy. We have come to the stage where both the medical and surgical man have each recognized the inadequacies of their particular field; a sensible viewpoint seems to be becoming prevalent whereby both are combining forces in the therapeutic management of the disease. As a general rule, this includes a preliminary attempt at medical cure, in which, if no other good be accomplished, the patient is brought into a more favorable and satisfactory condition for the employment of the middle step, the surgical operation. This latter, in the best hands, always includes, whenever it is possible so to do, the thorough removal of the ulcer-bearing area.

Operation ought, more and more, to be regarded as one of the incidents in the cure of the ulcer, the accomplishment of which may, and frequently does, necessitate further efforts; especially is it necessary to give much attention to the dietary regulations which are to be carried out for long periods of time after operation. These combined methods of treatment naturally result from the frequent necessity of treating post-operative symptoms in the operated cases. Just how the method works out in practice can be seen from the published report made by Richards.

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The combined method treatment adopted by Richards embraced preliminary medical measures which included the control of the free acid and pain by alkalies and, in many instances, by belladonna, and a long course of dieting. Of the medically treated patients 40 per cent. returned later for operation. The mortality of the medical treatment was *nil*. The average time that the patients remained under medical treatment following the operation was three months. Eighty-five per cent. of the patients reported very satisfactory results from the combined method of treatment. Richards emphasized particularly that there had been gross neglect on the part of the surgeons doing stomach work in the matter of post-operative medical treatment.

It is well to realize that while whatever type of operation is done may be followed by a cure or by an extirpation of the ulcerations, yet post-operative symptoms may be many and distressing which are due to other causes. Most of the trouble met with after operation is caused by dietary indiscretions. Post-operative symptoms do not always indicate that organic lesions are present, and in many the disturbances are of a functional nature directly induced by manifold indiscretions in diet, or by the too rapid and early introduction of highly acid gastric contents into the jejunal portion of the alimentary canal. In cases with marked disturbances of the secretory and motor functions accompanying the ulcer prior to operation, the tone of the stomach is much disturbed, and while the immediate effects of operations are all that is to be desired, especially from the patient's point of view, very soon the effects of the pre-operative disturbances come to the surface again, to be the cause for greater or less distress until the normal condition is reached or, as more often happens, approximated.

Such functional disturbances are the causes for symptoms after operation in the greatest number of the cases. In a great number of them it is to be presumed that the original ulcer had healed and that no new ulceration has appeared. And yet, the operation—and I speak now especially of gastroenterostomy—has distorted the physiology to such an extent as to be cause for subjective symptoms. Such a state of affairs brings to one's mind the question whether, when these functional symptoms appear and persist, and when one assures one's self at operation that they are based on no organic lesion—whether it would not be wisest to cut away the jejunal loop and restore the normal continuity of the alimentary canal; it brings up for serious consideration the propriety of doing gastroenterostomy in certain selected cases intentionally as a temporary measure. This would be applicable to those cases in which resection by any of the methods in use was not possible; and the restitution would only be possible in those cases in which at the primary operation no handicap to the subsequent reestablishment of normal conditions had been introduced.

In considering all of the symptoms it is well to note that any type of operation which is done causes a distortion of the normal structure or

relations of the stomach and probably of the normal nervous mechanism controlling the normal physiology. Even when all of the wounds are surgically healed in a manner most acceptable in the present state of our knowledge, certain changes in the physiology are inevitable because of the abnormal anatomy and are, probably, prolific causes for the appearance of post-operative functional complaints. Whether these are to be permanent or temporary disturbances susceptible to spontaneous disappearance, is difficult of decision, but it seems that almost in all a definite change has taken place which necessitates a readjustment with, or without, the aid of medical men. The conception furnishes a ready explanation of the good results which usually follow a gastroenterostomy for cicatricial pyloric stenosis; here an abnormality existing over a long period of time has caused a disturbed physiology and has gradually and efficiently prepared the organ for some new point of egress; our operation includes no new departure from this preparation, but merely assists nature in the compensatory adjustment of the initial condition and the result follows quickly with a minimum of post-operative symptoms.

In a small minority of the operated cases organic lesions are causes for the post-operative symptoms. Besides those with mechanical obstructions at the points of egress from the stomach, there are the cases of persisting or recurring ulcers, or of newly formed ulcers in the general region of the stoma—the so-called gastrojejunal ulcers. The problem of the gastrojejunal ulcer is most important and particularly baffling. For, whereas in the ordinary varieties of gastric and duodenal ulcer we have had nothing to do with the creation of the unhealable defect, in the gastrojejunal ulcers we have, ourselves, ploughed and planted the field upon which, later, the ulcers appear. The entire life history is open to us, but up to the present no success has followed the many attempts to elucidate the mystery. The various factors about which much is said as etiological causes for the secondary lesions must play an insignificant rôle; otherwise the number of gastrojejunal ulcers would far exceed the 2 or 3 per cent. of all the gastroenterostomies which are done.

Wright has pointed out the fact as noteworthy that there is an extraordinary preponderance of these secondary ulcerations in the male sex. In his cases the preliminary operations were as follows: Anterior gastroenterostomy, 38 cases; anterior gastroenterostomy with entero-anastomosis, 26 cases; anterior gastroenterostomy with entero-anastomosis in Y, 10 cases; posterior gastroenterostomy, 54 cases; posterior gastroenterostomy with entero-anastomosis, 3 cases; posterior gastroenterostomy with entero-anastomosis in Y, 5 cases; partial gastrectomy, 2 cases; not definitely stated, 7 cases. Evidently secondary ulcerations occur after all the ordinary types of operation.

Two types of gastrojejunal ulcer can be differentiated in accordance with the location of the lesion: (1) The defect located at the site of the anastomosis and usually ascribed to some fault in technic, such as the

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failure to cast off promptly some unabsorbable suture material, or to the want of accurate apposition, or the occurrence of excessive marginal necrosis. (2) The jejunal ulcer located at some distance from the line of suture usually in the efferent loop.

Anatomically true gastrojejunal or jejunal ulcers resemble the ordinary types of chronic gastric ulcer. Frequently, however, they are comparatively small lesions. The so-called "suture ulcers" show no resemblance to the latter; their gross characteristics are those of a narrow channel through which a foreign body is being extruded from the stomach wall. The manifestations of such "suture ulcers" may, however, be out of all proportion to the relative insignificance of the anatomical lesion; very extensive haematemeses are known to occur.

The symptoms include pain, vomiting, haematemesis, local tenderness, rigidity and frequently a local swelling. Pain is a very prominent symptom. The evidence presented by the Röntgen-ray is of a purely corroborative nature and is sometimes misleading. The clinical pictures are fairly characteristic and are as follows:

(1) A reproduction of the original symptom-complex occurs within a short time after operation and the patients believe that the old ulcer has reappeared. Progression of the symptoms and lesion may be very rapid, or the symptoms and signs continue much the same as before the operation.

(2) The symptoms develop slowly and gradually a tumor forms in the upper abdomen. At operation one finds that a fairly large ulcer has formed, has undergone subacute perforation and has become surrounded by a large mass of indurated and adherent intestine and omentum. Such a condition is best treated by jejunostomy.

(3) A tumor forms as in the previous group; suppuration occurs within it and the abscess ruptures into an adherent hollow viscus. Perforation into the colon gives a definite complex—rapid and extreme emaciation, diarrhoea of the lienteric type, vomiting of fecal matter or eructations of gas with a fecal odor. The latter usually occurs after a posterior gastroenterostomy. After an anterior gastroenterostomy the swelling tends to adhere to the anterior abdominal wall; an external fistula may result (Wright). Perforation into the free peritoneal cavity gives the usual symptoms.

## MARGINAL, GASTROJEJUNAL OR PEPTIC ULCER SUBSEQUENT TO GASTROENTEROSTOMY \*

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ADMITTED that the most frequent cause in recent years of the marginal gastrojejunal, recurring or peptic ulcer, so-called, following gastroenterostomy has been, and still is, ascribed to the use of non-absorbable material, silk or Pagenstecker, yet one must look further when the evidences of this type of ulcer are found in patients in whom nothing but absorbable material was used. Such ulcers are found frequently enough, but fortunately in a relatively small percentage when compared with the numbers of gastroenterostomies done for whatever cause or lesion.

One cannot entirely exclude the trauma produced by the varieties of clamps used in apposing the stomach and jejunum, nor the trauma produced by clamps such as the Allis, etc., in grasping and holding cut edges of either gastric or intestinal flaps. That the clamps of apposition and exclusion of leakage are causative in instances, I am quite convinced by personal observation of badly applied clamps, clamps of too rigid blades, and clamps too tightly locked; so that in any one of these instances, crushing of the mucosa and other layers may and does occur. Tearing of the mucosa and stripping off of patches by the rough application of Kocher, Allis, etc., types of clamps, used to hold in apposition or position the flaps, are readily accomplished. These contusions, abrasions, lacerations and stripplings are without question a basement foundation for ulcer formation.

A few years ago, while operating upon a perforated ulcer of the duodenum, I excised the area involved and had a pathological examination made. The result rather astounded me, as a report of specific (syphilitic) evidence was returned. Four other excised areas of perforated ulcers of this portion of the intestinal tract were returned, two with syphilitic evidence and two without, making a total of three out of five. Such results, therefore, force one to include in the list of causations of gastrojejunal, recurring or peptic ulcer the question of syphilis as a probable strong factor.

Heat as a factor in causation must be accepted in this type of ulcer as much as it can be in the production of the usual site duodenal ulcer (see Mayo), as hot foods and drink impelled by gastric peristalsis are forced against certain portions of the walls entering into the gastroenterostomy.

Bearing upon this thought of situation of peptic ulcer, in the series

\* Read before the New York Surgical Society, January 12, 1921.

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quoted in this article, the usual position was in the posterior wall of the stomach near the opening, or its posterior edge, in the lower portion of the jejunal surface of anastomosis, and in that portion of the jejunum distal to the anastomosis, *i.e.*, in the normal course of the jejunal peristalsis. Nor can we overlook the great possibilities in chemical changes as to the hyperacidity, etc., being a marked factor.

I am inclined to believe, as a result of findings in several patients of my own, that a personal idiosyncrasy exists in reproduction, or let me definitely say, production. An Italian, in whom I did a Billroth No. 2, all with absorbable catgut, for a suspected malignancy of the pylorus and duodenum, the specimen of which was reported by the pathologist as a benign duodenal ulcer with infiltration into the pyloric antrum, complained of almost the same symptoms fourteen months after operation, but with pain of a distinctly more severe character and extending toward the hypogastrium, well toward the pubes. Alkalies and food gave relief for months. Then, begging for relief, he was opened by me again and an area of ulceration and induration was found in the gastric wall, three-fourths of an inch posterior to the edge of the opening. A transgastric incision was made, and feeling that the original pathological diagnosis was incorrect and that now a malignancy metastatic with ulceration existed, I cauterized the area and then sutured the ulcer edges through the transgastric opening. About one month of relief followed and then all manifestations of the period previous were so far intensified that resection with grave outlook was accepted.

A wide resection of the ulcer was made, a section of jejunum over five inches long involved in the anastomosis was resected, a jejunostomy and subsequent gastroenterostomy were made. Recovery was without a thrill. Recurrence of symptoms appeared in eight months. There was a reoperation by another attending for adhesions and a cholecystectomy with no ulcer found. In this instance all dietary precautions had been taken.

The second patient in the reported series returned months after operation with aggravated symptoms, and deflected pain in almost the same zone as complained of by the patient mentioned above. He underwent prolonged treatment by gastric specialists and finally reoperation was resorted to. An ulcer was found on the posterior wall of the jejunum fully one and one-half inches long and one inch wide, densely infiltrated, extending well down in the distal portion of the jejunum. Excision of the ulcer, jejuno-jejunostomy and revision of the gastroenterostomy were done. Relief was prompt; recovery perfect. Recurrence of symptoms was reported within eight months, with the patient evidently in the hands of another set of gastric and surgical specialists.

These two cases have so impressed me with the idiosyncrasy idea that I am led to include so indefinite a causative factor in my list until some more plausible one be assigned, unless we accept the broad state-

ment that the cause of the original ulcer is not removed by our gastroenterostomies, treatments and dietary.

That the ever present bacillus or coccus must be given its due weight has not been forgotten in the causations—if the original ulcer was produced by a bacillus or coccus conveyance, then the recurrent or peptic ulcer must also receive full bacterial causation weight.

*Symptoms.*—These are very much allied to the manifestations of the ordinary duodenal ulcer with an added intensity, particularly in the evidences of after-eating distress, this often being described as very painful, and is reflected downward toward the pubes and lower left quadrant. After a short time relief by food and alkalies is negative. The patient fears to eat, as the distress is so great, and therefore a more evident loss of weight is present than in the ordinary duodenal ulcer. Painful spots on pressure may be elicited in the epigastrium, but not more so than in the duodenal type.

X-ray so far has not been satisfactory in interpreting the secondary ulcer. In but one of this series was there a suspicion of residue or barium in a new zone, and this opinion was based largely upon the pre-X-ray diagnosis of peptic ulcer, made by close observation and by the taking of a careful history.

*Prophylaxis.*—Avoiding all causative factors, beginning with a careful blood analysis for lues. The non-use of clamps when possible, the proper application of forceps and appliances used in preventing leakage and soiling; careful handling of the flaps when instruments are used for such purpose; the use of absorbable suture material throughout the anastomosis; the suturing of the mucosa of the stomach and jejunum in a separate layer producing a direct edge-to-edge apposition as in a skin suture and thereby aiding in a primary union of apposed mucous membranes and then the final layers, instead of the through-and-through suture employed by many, I feel may have a great influence in preventing this lesion.

Proper dietary directions and the seeing that these are carried out; the avoidance of hot drinks and foods, etc.; regulations of business, as the great nerve strains of some of our professions and occupations are well-known factors in exciting exaggerated disturbances when an ulcer is present—all these should be given proper attention.

*Treatment* of suspected marginal peptic, gastrojejunal or post-operative ulcer is essentially that of the primary disease. A fair medical test with failure should be followed by prompt surgical attention. Upon opening the abdomen the original site is inspected for a continuance of the old lesion or new areas of involvement; then the gastroenterostomy area should be given a very careful inspection, all adhesions about should be fully liberated and careful palpation for induration and excoriation made. The appearance of the involved area in this type of ulcer is very much the same as in the area involved in the original ulcer. The stip-

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pling effect is very characteristic. The examining finger palpating the site of the anastomosis meets with an infiltrated area and may also palpate the crater-like eroded ulcer.

In the event of finding suspicious or positive evidences, the anastomosis must be revised, the ulcer thoroughly excised, and a new anastomosis completed. Except in the event of the original ulcer having healed and no stenosis exists in the duodenum, after excising the ulcer at the site of the anastomosis, one should, I feel, produce a condition of normalcy by obliterating entirely the gastroenterostomy. This I was able to do in Case No. XII. In addition, if the appendix and gall-bladder are still present and there is any reason to suspect either of being causatives of infection, these should be removed. Recently I have been doing the Horsely operation in all patients in whom it is feasible, in the hope that this type of operation will be of more positive cure with less risk of secondary ulcer formation.

Appended is a list of some of the patients in whom I have revised the primary operation for this condition, at the Post-Graduate Hospital and one sanitarium, during the past five years:

CASE I.—I. S., July 24, 1917. Diagnosis: Gastrojejunal ulcer. Operation: Gastroenterostomy; removal of a linen thread; suture. Findings: Misplaced stoma. Revision; recovery. X-ray diagnosis: peridiodenal adhesions.

CASE II.—I. S. (same as above), October 26, 1917. Diagnosis: Ulcer at the site of the old gastroenterostomy. Operation: New gastroenterostomy made; cauterization of the ulcer; another thread found. No X-ray report this time.

CASE III.—M. C., August 2, 1918. Diagnosis: Peptic or gastrojejunal ulcer, opposite the site of the stoma, in the jejunum. Former operation done eight months previous. Operation: Resection of the ulcer; revision of the gastroenterostomy; with recovery. X-ray diagnosis: New ulcer (?), speck of residue remaining.

CASE IV.—I. S., December 13, 1918. Two previous operations (as recorded above in No. 1 and No. 2). Diagnosis: Gastric ulcer at site of old gastroenterostomy. Operation: Resection of another ulcer, with revision of gastroenterostomy. Recovery. X-ray diagnosis: Negative.

CASE V.—L. G., February 20, 1919. Had been operated upon three times within a short period at one of the hospitals in the city, the first operation being June, 1917. Diagnosis: Stenosed stoma, after gastroenterostomy, with ulcer. Operation: Enlargement of the stoma, resection of the ulcer.

CASE VI.—L. K., November 28, 1919. Diagnosis: Ulcer following gastroenterostomy ten months preceding. Operative diagnosis: Misplaced stoma, ulcer in the edge of the stoma. Operation: Closure of the old gastroenterostomy, excision of the ulcer, new gastroenterostomy to normal site.

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CASE VII.—M. H., August 20, 1920. Diagnosis: Gastrojejunal ulcer—date not given for the performance of the gastroenterostomy. Operation: Dissection of adhesions, revision of the gastroenterostomy, resection of the ulcer.

CASE VIII.—J. S., September 27, 1920. Previous operation by me eight years before. Present operative diagnosis: Peptic ulcer of the gastric border of the stoma following gastroenterostomy. Operation: Resection of the ulcer, revision of the gastroenterostomy.

CASE IX.—Italian: M., aged fifty years. Admitted to my service November 19, 1913. Operation December 5, 1913. Diagnosis: Duodenal ulcer; question of malignancy on account of the massive infiltration. Operation: Pylorectomy, posterior gastroenterostomy—all done with catgut. Early discharge, cured. Readmitted February 15, 1915, X-ray diagnosis: Patent stoma, nothing else. Discharged February 21, 1915. Readmitted March 16, 1916. Operation next day. Operative findings: Peptic ulcer, finger's breadth back from the margin on the posterior stomach wall, the size of a ten-cent piece. Transgastric cauterization and suture of the ulcer area. Readmitted April 4, 1916. Exquisite suffering—patient demanding operative relief. Operation: Resection of five inches of the jejunum and of the entire gastroenterostomy margin, including the ulcer, end-to-end anastomosis of the jejunum, gastrojejunostomy. Discharged within sixteen days in excellent condition. Readmitted March 8, 1919. Operation on another service. Diagnosis: Subperiosteal abscess of the maxilla; perigastric adhesions; chronic cholecystitis. Operation: Freeing of adhesions; cholecystectomy.

CASE X.—S. K., operated upon for a duodenal ulcer two years before, because of pronounced symptoms, exquisite pain, etc. Operation, done at a private sanitarium, revealed a large peptic ulcer in the jejunum, fully one and one-half inches long by one inch wide, in the distal margin of the opening, extending well into the otherwise normal intestine. Resection of this portion of the gut, reanastomosis, with revision of the gastroenterostomy. Cured. Symptoms recurring within the course of twelve to fourteen months.

CASE XI.—F. M. A most interesting case is that of F. M., aged thirty-one years. When I saw him on November 21, 1915, he gave a history briefly as follows: Alcoholic habits marked; mastoid operation July, 1913; returned from a European trip December, 1913; worked until May, 1914, when he observed that his stomach had gone bad. In fact, close questioning produced the typical symptoms of a duodenal ulcer, for which he was operated upon in one of our hospitals in this city. A pylorectomy for duodenal ulcer was done, with a *supposed* typical posterior gastroenterostomy, just one year and two days before his seeing me, i.e., November 19, 1914. With the exception of three weeks, he had been worse than before the operation.

On the day of his first examination by me he gave a history of awakening at from one to four in the morning with violent cramps and feeling very weak. When arising he ate breakfast, which

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affected him least of all meals. Meals, as a rule, followed by fearful distress, distention, etc. Occasionally the distress did not begin before 11 A.M. Vomited readily. Dinners distressed him fearfully—necessitating the taking of Na. B. C., etc. Loss of weight was more than usual in such cases. He was up two hours, the night previous to seeing me, with unbearable cramps in left side and down over the bladder. Vomited only bile and mucus.

Patient went to Rochester, Minnesota, in August, 1919, where he received conflicting opinions and advice, but was definitely advised that he was neurotic, that he should go to work and quit nursing an idea. He returned east, had his teeth all fixed, and thought there was some improvement in his condition. The improvement was due to taking only soft foods. Again said his pain was all on the left side—the entire left side—and at 1 to 4 A.M. he was relieved by taking food and occasionally Na. B. C. Again requested operation.

Examination revealed plus, plus sensitiveness to abdominal palpation, chiefly in left side; some visible (?) peristalsis, not definite. I advised exploration. This was not accepted, as the parents were much opposed to further operation.

On November 13, 1915, he returned, stating that no pylorectomy was done, but later operation revealed that this was done, an appendectomy also. On June 18, 1917, in the eighteen or twenty months since first seeing this patient, he had led a life of misery and suffering to such a degree as to cause him to express the desire to commit suicide. During these two years he had been in all the accredited and non-accredited gastro-intestinal institutions from the Atlantic to the Pacific coast, and also all the retreats for "Worn Out To Be Rebuilt" that the elusive and seductive advertisements can reach. On two other occasions besides that of November 13, 1915, I advised exploration. Finally, in his suicidal determination, he grasped at the exploration suggestion, and upon June 18, 1917, during our war activities, he was operated upon by me at the Post-Graduate Hospital, requesting: "Get me in shape as fast as you can so that I can be of some service to the country."

*Operation (June 18, 1917).*—A sharp angulation of the transverse colon was found with its apex attached to the site of the gastroenterostomy, with an area of thickening and stippling at the stoma margin. On attempting to release this colonic angulation it was observed that a communication existed between the colon, the stomach and duodenum. The opening in the colon was about the size of an ordinary lead pencil, an ulcer existing at the anastomosis, while the gastroenterostomy stoma was considerably contracted.

The opening in the colon was sutured, the marginal ulcer excised and the gastroenterostomy stoma revised. The patient had a slight infection of his skin wound. Discharged. Entered the service, was wounded in the thigh, and transferred to the tank service, where he developed a post-operative hernia. He continued until the armistice, returning with the rank of captain.

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During all his recitals of his various travels previous to operation, he never gave a record of vomiting anything that resembled fecal or stercoraceous vomitus, but on post-operative cross-examination, he acknowledged that while in a very prominent gastrointestinal retreat in New York City, he had, on several occasions, vomited foul-smelling and tasting brownish fluid, that the attention of the doctors and nurses was called to the fact, but evidently no impression was made by it.

The last reports, during November of this year, three years following my revision operation, are those of excellent health.

Cases No. XII and No. XIII have been under observation during the week of December 12th to 19th.

CASE XII.—L., patient operated upon by me in February of this year. Excision of an ulcer on the anterior superior surface of the first portion of the duodenum revealed a contact or kissing ulcer on the opposite wall. This also was excised, and fearing a marked stenosis, a gastroenterostomy was added. Five months after operation the patient complained of almost the same symptoms. In the course of sixty days his condition was such as to warrant my reopening him and the patient himself asked for operative relief.

This was done December 17, 1920. On exposing the duodenal zone, I was surprised to find an unusually wide duodenum; in fact, wider than the usual. There was no evidence of a new ulcer and only a faint scar; while opposite the anastomosis in the jejunum an ulcer with deep walls and about the size of a dime was demonstrable. The ulcer was excised, the openings in the stomach and jejunum closed, with so far a perfect result.

Case XIII is a further interesting record of Case VI. Last operation of three or four in New York was done by me at the Post-Graduate Hospital, November 28, 1919. It consisted of a revision of the former operation, with excision of an ulcer and repair of a ventral hernia. There was relief until January or February of this year; in April he went to Rochester, Minn., and on April 8, 1920, was operated upon again. Relief for about two months followed. Patient returned to this city. On December 17, 1920, I was asked to take care of him, as he was bleeding from an ulcer. Up to date, December 24th, he has had three hemorrhages. The operating surgeon at the Mayo Institution stated that another gastroenterostomy was performed with repair of a ventral hernia.

## GASTROENTEROSTOMY IN ACUTE PERFORATED ULCER OF THE STOMACH AND DUODENUM\*

BY JOHN B. DEAVER, M.D.

AND

DAMON B. PFEIFFER, M.D.

OF PHILADELPHIA, PA.

IT IS but a few years since the surgeon first began to save from certain death the victims of that most dramatic of acute abdominal seizures, perforated ulcer of the stomach and duodenum. Yet most of the points concerning its treatment can already be regarded as settled.

All success is based on early treatment. Better an early operation by an indifferent surgeon than a late operation by a master. The second essential is efficient suture of the opening. Successes are occasionally reported by other means such as tamponade, drainage to the ulcer site, omental plugs, the use of an adjacent structure as an occlusive patch, or the suture of a tube into the opening to form an external fistula. Such makeshifts are more apt to succeed in gastric than in duodenal ulcer, but in both they are accompanied by prohibitive mortality and in no sense and under no circumstances do they rival direct closure. I have never failed to effect a direct closure by suture and can scarcely picture a case of perforation into the free abdominal cavity in which the surgeon who is familiar with the exposure, mobilization and suture of viscera could find it impossible to close a spontaneous perforation.

So far do these two fundamental principles of treatment transcend all others in importance that contributions bearing on other points in the procedure must occupy a distinctly subordinate place. Nevertheless, such considerations are important and the judgment with which they are employed will be reflected in mortality percentage.

I have never felt it was wise to advocate the excision of perforated ulcers, though there are many early cases in which, doubtless, the operation could be performed with great safety. Rövsing and certain Swedish surgeons have reported excellent results and a very low mortality in selected cases. In only one instance have I felt justified in removing the ulcer by partial gastrectomy, and this was in the case of a patient who perforated while in the ward awaiting operation, so that to all intents and purposes it could be treated as a clean case. The lesion was a large callous ulcer of the lesser curvature near the pylorus with a history of fourteen years' duration. It seemed a suitable case surgically and pathologically for excision, and the fact that it had just perforated

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spontaneously was not allowed to influence the decision to remove it. The patient recovered, though it was evident that the shock of perforation appreciably added to the strain of the operation which ordinarily is not productive of shock. In general surgeons are agreed that excision of acute perforated ulcer, as ordinarily seen a few hours after its occurrence, offers nothing of immediate life-saving value to compensate for the added time and trauma of the operation.

However, concerning simultaneous gastrojejunostomy in the treatment of perforated ulcer there is as yet no general agreement. The arguments pro and con have become rather familiar to most of us and are largely theoretical. Statistics of results which have been offered in favor of one or the other contention have been very confusing for the reason that early operation and skilful closure of the perforation so overshadow every other consideration that it is difficult to draw conclusions concerning the advantages or disadvantages of adjuvant procedures. Still it is our belief that experience will eventually point out the best method and to this end reports of individual results are still desirable.

It is now about fifteen years since we adopted the primary posterior gastrojejunostomy as a feature of the operation for acute perforated ulcers of the stomach or duodenum. Since that time in my service in the Lankenau Hospital of Philadelphia, sixty-seven acute perforated ulcers of the stomach or duodenum have been operated upon with five deaths, a mortality of 7.5 per cent. The earlier cases have been reported previously on several occasions. During the time of the preparation of this paper, owing to temporary conditions obtaining in the record room of the hospital incident to expansion of space and clerical force, a number of the earlier records have been unobtainable. We have therefore based the statistical study of this paper on the last fifty-five cases, among which there were four deaths.

It is remarkable that there was but one female to fifty-four males in this series. In Philadelphia perforating ulcer in the female is a rare occurrence, the proportion being much below that of the clinics in the British Isles and European countries. Seventeen ulcers were gastric, including the one female, and thirty-eight were duodenal. Eighty per cent. of the cases occurred between the ages of twenty-five and forty-five years, and the decade of greatest incidence was the fourth, which contained 40 per cent. of the total number. The ages ranged from twenty years to sixty-one years.

This series confirms the many able descriptions of the clinical picture and diagnostic features of the condition. A history of previous indigestion is common. In approximately one-half the cases (28) there was a clear history of gastric disturbance of ulcer type preceding the perforation. Approximately one-quarter (14) gave a history of previous indigestion of slight, occasional, or non-distinctive character, while the remaining quarter (13) gave no history or such a vague history of indi-

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gestion that no importance could be attached to it. It is still worth noting for the benefit of those who lay stress on bleeding as a sign of ulcer that haematemesis and melena were each encountered but twice in the previous history of the entire series. The duration of gastric disturbance before perforation varied from two weeks to thirty-two years. Perforation may be said to have been the first symptom in about 20 per cent. Of the cases whose symptoms should have apprised the attending physician of the existence of organic abdominal disease, but few (4) perforated within the first year of symptoms. Twenty-eight cases (51 per cent.) perforated during the first eight years of symptoms, being quite evenly distributed throughout that period.

Excruciating pain marking the moment of perforation, followed promptly by abdominal rigidity so marked as to merit the common term "board-like" were the distinguishing diagnostic features. Initial vomiting almost always occurred, but was not invariable. Tenderness paralleled rigidity, being most marked over the most rigid area. The greatest rigidity was usually in the epigastric region, though as time went on the lower abdomen, particularly the right side, became quite as spastic as the upper zone.

The amount of initial shock is difficult to determine, as the patient is rarely seen in the first throes of the seizure. There is reason to believe that a certain amount of shock is common immediately following perforation, but at the time the patient was first seen, true shock was not present. It was not uncommon for a patient to exhibit pallor and the facial expression of desperate illness, but it was seldom that the apathy, rapid feeble pulse, and low blood-pressure which characterize true shock were observed. Often reaction had occurred, the temperature, pulse and respiration were but little disturbed, and the diagnosis depended chiefly upon the history and the abdominal signs. Attention has repeatedly been drawn to this so-called latent period in perforating ulcers.

On admission the temperature range in this series was from 96° to 100.4°, the average being 98.2°. The pulse varied from 64 to 152, average being 92, and the respiration from 20 to 40, average 31. The average temperature, pulse and respiration, therefore, were 98.2°—92—31. This is remarkably little variation from the normal for a condition so soon to show its lethal character and is a common cause of error for the unwary practitioner.

The leucocytes varied from 2900 to 25,750 per cu. mm., averaging 13,700. In the few fatal cases the count was below 10,000 in each, being respectively 4500, 4800, 9600 and 9600 per cu. mm. The polynuclear percentages in these five cases were 53 per cent., 62 per cent., 78 per cent., and 77 per cent., respectively. It would seem, therefore, that a low leucocyte count with a low percentage of polynuclears is a bad diagnostic sign though exceptions occur, as shown by the remarkably low count of 2900

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in a successful case and seven other cases in which the count was below 10,000.

Concerning the important factor of time elapsed before operation, the following table is explanatory:

Time Elapsed	1-6 hrs.	6-12 hrs.	12-24 hrs.	24-72.	Unknown.
Lived .....	25	12	5	4	6
Died .....	1	2	1	0	0

This table shows the ascending trend of mortality with the increase of elapsed time before operation, which has been so well emphasized by Moynihan, Caird, Walker and others. During this same period seven other patients with perforation were admitted to the hospital in a moribund condition and died without operation. Were these patients added to the above table the difference in mortality in the last group would be more striking and the combined medical and surgical mortality of the entire series of seventy-four patients would be twelve, or 16 per cent. It is not our practice either to refuse a chance to a patient or to waste the resources of surgery upon the dying, which we regard as a species of maltreatment to the patient that reacts upon surgery to its discredit. Nothing so impresses the lesson of the disastrous consequences of delay as refusal to operate and thereby cover the error.

The operations performed are as follows:

	Gastric Perforations			Duodenal Perforations		
	Recovered	Died	Mort. Per Cent.	Recovered	Died	Mort. Per Cent.
Suture and post gastro-						
jejunostomy .....	9	1	11.1	33	2	6
Suture only .....	5	1	20	3	0	0
Pylorectomy .....	1	0	00	0	0	00

The appendix was removed in twenty-one cases and the gall-bladder in two. Both cases in which cholecystectomy was added recovered, as did all appendectomies except one. The appendix is frequently diseased in these cases, as is well known, and I observed, about a year ago, a fatal case of appendicitis which developed in a young man upon whom a successful operation for perforated duodenal ulcer had been performed by another surgeon some months previously.

A glance at these figures shows that there is no evident discrepancy in immediate results that could be attributed to the performance or non-performance of the primary gastrojejunostomy. The mortality of 20 per cent. in the group treated by suture only, as compared with 7 per cent. in the series where anastomosis was made, carries no conviction, because of the small number of cases treated by suture only and the further fact that four of these cases were so treated because they were obviously bad operative risks. The remaining five cases treated by suture only were operated upon by others in my service who were less inclined formerly to add gastroenterostomy to suture. On the other hand, it must not be

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supposed that all forty-two recovered cases in whom gastroenterostomy and often appendectomy, and in two cases cholecystectomy, were added were first-class operative risks according to usual standards. They averaged about eight hours from the time of perforation. They showed the typical clinical picture of acute perforation. The majority presented an extensive peritonitis with much fluid exudate. Often the perforation was large and there had been escape of food particles. The only characteristic in common that was remarked was that they behaved well on the operating table so far as respiration, aeration and circulation were concerned. It is a general rule that it is bad judgment in any operative procedure to prolong surgery after a patient shows signs of embarrassment of these vital functions. This applies to perforated ulcer surgery with equal force, but I cannot see that it has much bearing upon the advisability or inadvisability of primary gastroenterostomy, for if anything can be demonstrated by experience such a series as this shows that the operation *can* be done with safety if the surgeon uses surgical judgment in selecting his cases, and, more than that, it demonstrates that the operation is practicable in the vast majority of cases.

That an operation is practicable is in itself no good and sufficient reason for doing it. Our reasons are that we believe it gives a lower primary mortality and a better outlook for the future.

Consider the following facts with respect to the immediate mortality which is the feature chiefly stressed by the opponents of primary gastroenterostomy on the ground that it unduly prolongs the operation and spreads infection. Of the entire sixty-seven cases in the series fifty-five had the simultaneous anastomosis with three deaths, mortality 5.5 per cent. Of the twelve cases that had no gastroenterostomy, two died, mortality 17 per cent. But it may be urged that these series were selected in such a manner as to throw the heavier mortality in the latter group. In a measure this is true, but as we have no parallel series operated upon by simple closure let us take the results of those who are satisfied with the simpler procedure. Struthers reports the largest series, ninety cases with twenty deaths, a mortality of 22.2 per cent. The report is too brief to show definitely the type of operation in all cases, but Struthers in common with the Edinburgh School rejects gastroenterostomy as a primary operation, except for stenosis. Murphy in England reports twenty-eight cases of ruptured gastric ulcer in soldiers, treated by suture only, with two deaths: mortality 7.1 per cent. This is an excellent showing, but it must be remembered that he was operating upon a selected group of good physical subjects, and with very few exceptions his cases were brought to operation in the early hours after perforation. No end-results are given.

Gibson, in 1916, reported fourteen cases similarly treated with one death; mortality 7.1 per cent.

Walker reported from the Boston City Hospital ninety-eight cases

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with twenty-one deaths; mortality 26.9 per cent.; almost all these cases were treated by simple suture.

Alexander reported thirty cases with nine deaths, a general mortality of 30 per cent. Ten of these cases were treated by enterorrhaphy and posterior gastrojejunostomy without a death, the nine fatalities occurring in the cases treated by simple suture. In spite of this record, Alexander concludes that gastroenterostomy is unnecessary because he could see no differences in the after-results of the two types of operation in the fourteen cases followed.

Richardson reported ninety perforations in the Massachusetts General Hospital with thirty-two deaths; 35.5 per cent. mortality. Only twelve cases were subjected to primary gastroenterostomy, of whom two died; mortality 17 per cent. In spite of the lower mortality Richardson condemns primary gastroenterostomy, saying that these were selected cases. He then states that these two deaths were due in one case to diabetic coma and in the other to delirium tremens which somewhat impairs his statement as to selection.

Many other series may be instanced but no point would be served. To offset those who have had favorable runs of cases by simple closure I may say that at one time I had over thirty consecutive cases treated by closure plus primary gastroenterostomy without a death.

In short, we are certain that the mortality of acute perforated ulcer is not increased by simultaneous gastroenterostomy provided it is done quickly, and not attempted in cases obviously shocked. We have, moreover, a distinct impression that the operation has given a lower primary mortality not only in the hands of those who use it routinely, but with those who employ it only occasionally for more narrow indications, and then explain their lowered mortality by saying that it was done only in selected cases.

There has been much talk on the subject of the dangers of infecting the lesser peritoneal cavity by opening the transverse mesocolon for the performance of gastroenterostomy. But no one seems able to report a case in which there is good reason to believe that this has occurred, and moreover, as we pointed out years ago, and since verified by others, much of the exudate that is poured out so richly in these cases is in reality sterile or relatively so, being a response to the chemical irritation of the gastric and duodenal contents rather than the result of bacterial inflammation. In this series there were thirty-four cultures of the fluid in the peritoneal cavity which were sterile in twenty-three cases and positive in only eleven.

Another point which has always seemed strange to us is the denial by the antagonists of the operation that gastroenterostomy possesses either a favorable early or late influence upon those patients admittedly the subject of the disease for which gastroenterostomy is acknowledged to be the cornerstone in treatment. A surgeon whose mind works in this

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peculiar fashion would never think of operating upon an ulcer in the pre-perforative stage by simple suture without gastroenterostomy. Yet the moment a spontaneous perforation has occurred, however small or large and wherever situated, he feels that the ulcer has now demonstrated that it is on the high road to recovery provided it has not succeeded in giving the patient a fatal peritonitis. Much has been said about the favorable influence of perforation *per se* upon the healing of ulcer. Gibson blandly and epigrammatically remarks that he "considered it unwise to do a gastroenterostomy for a condition which is going to be cured anyhow." While that may have been his experience in a small consecutive group of cases, and although many have been struck with the fact that ulcers treated by inversion often give no further trouble, it is now becoming clear that perforation in itself is not a guarantee of cure. Gibson's experience that all ulcers are cured by perforation and simple suture must be exceptional. We are unable to report the end-results in the entire series, as many of our cases belong to the class that are exceedingly hard to follow and our follow-up system, being of recent organization, has been unable to find many of them. However, we have records of the later condition of twenty-one patients (40 per cent.).

	End Results.		
	Good	Im- proved	Unim- proved
Suture only .....	2	0	2
Suture and posterior gastroenterostomy .....	17	0	0

Of the twenty-one cases only two were unimproved and these were both cases in whom gastroenterostomy was omitted. In one case suture only of a duodenal ulcer was made because of the bad condition of the patient. After recovery he still had indigestion and returned three months later for gastroenterostomy. He left the hospital symptomatically relieved and no further report is available. The second case was one of perforation of the anterior wall of the stomach, in good condition at the time of operation. He was operated upon by one of the assistant surgeons who omitted the gastroenterostomy. After recovery he had persistence of digestive troubles and two years later was readmitted for perforation of the posterior wall of the stomach. This was sutured and a posterior gastrojejunostomy made, since which time, eighteen months ago, he has remained well and without gastric symptoms. Lewisohn has recently reported five cases of recurrent or persistent ulcer after suture of spontaneous perforation. Alexander followed fourteen cases of whom seven had been treated by suture only and an equal number by suture and posterior gastroenterostomy. He found only one case entirely well and this was treated by suture only. This experience is at the opposite pole from Gibson's results, who reported that all his cases of simple suture had remained well. In all such studies it is well to remember that, even before perforation, ulcers may give no evidence of their

presence or but the slightest symptoms in 20 per cent. of the cases, as in this series. Struthers reports 40 per cent. of his cases as having either no disturbance or only the mildest gastric troubles before perforation. It is not surprising, therefore, that many ulcers after closure give little or no evidence of their presence even though unhealed. The base and edges have been put at rest by inversion. Rest, restriction in diet, and medication have exercised a favorable influence. It is quite probable that healing occurs in some cases. However, that healing is not the uniform result is shown by the cases already reported and by the experience of Sullivan, Taylor, Field, Wise and many others. Even Eliot, strong antagonist of primary gastroenterostomy, has collected seventy-five cases in which there was evidence of ulcer symptoms or later complications, such as hemorrhage or perforation, which might have been prevented by gastroenterostomy. We have learned, it is true, that gastroenterostomy is not always successful in relieving ulcer symptoms or in preventing complications, but we consider that it has been abundantly demonstrated that it is successful in such a high percentage of cases that there is no longer any doubt of its specific effect. The same arguments that are urged against gastroenterostomy in perforated ulcer may be urged and are urged by some of our medical colleagues against this operation in the treatment of chronic ulcer.

To our minds there are only two arguments of special and one of general nature that need be considered against primary gastroenterostomy. The general argument is one that has not been urged but should, nevertheless, be taken into account; namely, the liability to gastrojejunal ulcer. It would indeed be sad if a case that would have recovered entirely with suture only were to be subjected to gastroenterostomy and thereby acquire a gastrojejunal ulcer. If we were to generalize upon our own experience we might claim that this does not occur in the gastroenterostomy made for perforating ulcer, for we have had no such experience, but it is unsafe to draw deductions from the experience of a single series. Petren has reported such a case. The possibility is to be recognized but the incidence must be low. Unless it be considered a contraindication to gastroenterostomy for chronic ulcer it cannot be employed against the operation for perforating ulcer when the advantages are similar.

The weighty arguments of special nature are:

(1) That the mortality in unskilled hands will be increased by the addition of gastroenterostomy. (2) That even in the best hands gastroenterostomy will certainly raise the death-rate when used in desperately sick cases, whether early or late. To both these assertions we agree. Unless the surgeon is able to make the anastomosis quickly and with irreproachable technic simple suture is the safer operation. But let us not cloud the situation by pretending that the patient so treated as an

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emergency is as likely to remain free from ulcer symptoms or complications as if he had been given a gastroenterostomy as well.

Again, we repeat the statement made in the body of the paper, that it is not wise to insist upon making a gastroenterostomy in the presence of shock or evident systemic toxæmia. These cases are not numerous within the first twelve hours after perforation, but they do exist. The importance of gastroenterostomy as a primary procedure is not so great as to warrant accepting obviously increased operative risk. That it does not increase the primary mortality in properly selected cases we consider to have been demonstrated. On the contrary, there is good reason to believe that it promotes convalescence and actually diminishes mortality. Accumulating statistics and more accurate follow-up records are dispelling the fallacy that perforation cures ulcer and tend to show that primary gastroenterostomy lessens the likelihood of future ulcer symptoms and complications.

## COMPARATIVE RESULTS OF PYLOROPLASTY AND OF GASTRO-ENTEROSTOMY IN STOMACH SURGERY\*

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FOR a long time the leading internists have been criticising the results in gastric surgery. So many complaints from such a source should not be ignored. To be sure, we may very fairly come back with the retort that after medical treatment has failed, where surgery relieves 60 to 70 per cent. of these cases, the medical man has little ground for criticism.

In a recent article by Bastedo, of Columbia University, he makes the startling statement that "in our own practice ulcer cases that have had one or more operations come for treatment almost as frequently as ulcer cases that have not been operated." This seems to be an extreme assertion, but when we ask almost any internist of his experiences he voices the same sentiment. Smithies, out of 226 cases of gastroenterostomy operations for gastric and duodenal ulcers traced, reports only fifty-seven, 20.9 per cent., were clinically free of complaints. It leads one to ask if the operative results in this field are good enough to satisfy the composite surgical conscience.

As the results now stand, from 15 to 40 per cent. of the operations done for gastric ulcers are failures. At least they do not restore the patient to sound health. There has been a tendency to explain the imperfect results on the ground that the operation was ill advised and the technic faulty. Moynihan asserts that many of the poor results following gastroenterostomy have been due to: (1) Operation done in the absence of any organic lesions justifying it; (2) in cases of chronic extragastric lesions that have been overlooked; (3) incomplete operation, the ulcer not having been dealt with; and (4) various defects in technic.

I am willing to concede that many of the failures are avoidable, but even with these surgical errors eliminated, numerous cases report for treatment with symptoms little improved, or as bad or worse than before the operation. The stubborn fact is that there are many disappointing results following gastroenterostomies done by the best surgeons following the most approved methods.

Wilensky, speaking of the current operations for ulcer, says: "None of these methods are ideal, however, and numerous recurrences of symptoms testify amply to the fact that the last word has not been said in the treatment of ulcer, and account for the diligent efforts which are everywhere being made to improve the surgical method of therapy for gastric and duodenal ulcer." Robert Hutchinson concluded that: "Gastroenter-

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\* Read before the Western Surgical Association, December 4, 1920.

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ostomy profoundly affects the gastric functions, both secretory and motor, and it is not the simple drainage procedure sometimes pictured."

When one stops to analyze the revolutionary changes in the physiology of the stomach which follow a gastroenterostomy, the operation usually practised in gastric and duodenal ulcer, one is not surprised at these statements from such eminent authorities.

Normally the food, when it enters the stomach, is subjected to a very thorough grinding and mixing with the gastric juice, and, as stated by Howell: "There is a certain orderliness in the movements of the stomach, and especially in the separation and ejection of the more liquid from the solid parts, which shows the existence of a specially adapted mechanism." Chymification is complete before the closed pyloric sphincter permits its entrance into the pylorus.

As soon as the acid chyme enters the duodenum the prosecretin is transformed into secretin and the pancreatic secretion begins. Then by the process of "rhythmic segmentation," so vividly described by Cannon and Blake, the duodenum, by means of vigorous churning movements, brings the bile and pancreatic ferments into intimate contact with every particle of the chyme before it is permitted to pass onward into the jejunum. This thorough contact is necessary to insure complete digestion.

When a gastroenterostomy opening is made, if it functions as the operator desires it to do, a revolutionary change in the physiology of digestion takes place. When one considers the coarse boluses of food, imperfectly charged with gastric juice, which are propelled through the artificial stoma into a jejunum unprepared for such treatment, and with no special mechanism for mixing the food boluses with the bile and pancreatic juice, one wonders that gastroenterostomized patients get along as well as they do. That such a radical upsetting of the normal mechanism does not always produce disaster speaks volumes for the adaptability of the human digestive function.

Bayliss and Starling proved that when they isolated a loop of jejunum by cutting off the nerve supply and ligated both ends of the loop, and then injected 10 c.c. of a 0.4 per cent. solution of HCl, pancreatic secretion promptly began. But Bayliss and Starling and Wertheimer and Lapage showed that the greater the distance from the pylorus the acid entered the intestine the less pronounced the effect, and the scantier the pancreatic secretion. It is fair to conclude that to get the best functional activity of the pancreas the abundant secretin formed by the presence of the acid chyme in the duodenum is necessary, and that when the gastric juice enters the intestine lower down the normal physiological activity of the pancreas is somewhat impaired.

Entire satisfaction with any operation can never be obtained till the failures and disappointments are reduced to a minimum. The poor results following gastroenterostomies have too often, it seems to me, been set down as due to faulty technic, to having been done in the absence of

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organic lesions justifying the operation, to incorrect diagnosis, etc., and apparently without considering that there may be some inherent fault in gastroenterostomy, bound to be followed by many poor results, no matter how carefully the case is chosen nor how technically perfect the operation.

Moynihan, while believing that many bad results follow ill-advised and technically imperfect operations, frankly admits that other cases, done according to the best light we have at the present time, have some very unpleasant sequelæ. He sums up the prevailing symptoms complained of by these uncured patients as pain, vomiting, hemorrhage, and diarrhoea. Regarding these four symptoms it can be shown that any or all of them may and frequently are caused by altered physiology and by the stomach emptying at a point more or less remote from the general direction of the peristaltic wave, and entering the intestine at a point not physiologically adapted to the function thus forced upon it.

*Pain*.—Moorhead shows that the pain is sometimes due to forcible peristalsis against a closed pylorus. He has found in these cases the pyloric antrum is dilated and its muscular wall hypertrophied. Watching with the fluoroscope he has noted that at the exact moment a strong peristaltic wave has impinged against the pylorus the patient has experienced the exact type of pain for which he seeks relief. Pain is also due to recurrent or unhealed ulcers, also to the occurrence of jejunal ulcer, which, I believe, is much more frequent than usually supposed. Although often due, no doubt, to unabsorbable sutures, many cases have been reported where jejunal ulcer has followed gastroenterostomy when none but absorbable sutures have been used. A jejunal ulcer is a more serious lesion than that for which gastroenterostomy is usually done. Colic and intestinal soreness are a frequent result of the rapid entrance of coarse unchymified food into the jejunum. This material is usually highly acid, not having been neutralized by the alkaline bile and pancreatic juice.

*Hemorrhage*.—Most of the sources of hemorrhage will be the same regardless of the type of operation, but the one very frequent source, jejunal ulcer, is a direct result of gastroenterostomy.

*Vomiting*.—Obstruction, because of a kink of the efferent loop of the jejunum, was found by Cannon and Blake to be the most frequent cause of failure after gastroenterostomy. Vomiting from this cause is frequent, no matter who the operator nor how carefully he may seek to avoid this condition. Bile and pancreatic juice enter the stomach through the artificial stoma, and if the pylorus is patent more or less vomiting is likely to result from this cause. Improved technic has almost wholly overcome the acute early vicious circle which formerly cost so many lives, but it is impossible to get away from the fact that a vicious circle is often the cause of ill results, though it is not so deadly as when the long loop operation was in fashion. Reflex vomiting sometimes occurs as the

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result of a severe colic produced by the rapid filling of the small intestine when the stomach empties too rapidly.

*Diarrhaea.*—This is a frequent result of gastroenterostomy and it is probably usually due to too rapid emptying of the stomach. The food that enters the jejunum is not well mixed with the gastric juice and little, if at all, with the bile and pancreatic juice. Normal digestion, under such conditions, is impossible, the food acting merely as a foreign body and an irritant to the intestinal mucosa. A resulting diarrhoea is the natural consequence. It is fair to say that the diarrhoea is probably beneficent since it gets rid of an irritating foreign element. Andrews and Mix have recently reported a case where the entire food taken passed directly through the stomach, via the gastroenterostomy stoma, without time for any action by the gastric juice. It was necessary to get an X-ray picture within thirty seconds of the time the opaque meal was ingested or they found the stomach empty. Doctor Andrews gave this condition the highly descriptive name of the "Dumping Stomach." Cramping of the bowels and what the patient called explosive bowel movements were complained of with general soreness over the abdomen and loss of weight.

Most of the symptoms that have been noted are due inherently to gastroenterostomy. They are the result of a disturbed physiological process. The act of digestion is one of the most important functions performed by the body, and it would be a great boon if it could be found possible to relieve the distressing symptoms of ulcers and stenoses by a less revolutionary procedure. Gastroenterostomy has saved thousands of lives and will continue to save lives in certain types of trouble, but it seems to me there are reasons without number why a more physiological method should be adopted in the treatment of many of these cases.

Given the bare physiological facts without any of the prejudices of past experience, there is not one among us who would not consider the rational manner of dealing with the problem would be excision or cauterization of the ulcer and enlarging of the natural outlet sufficiently to secure free unhindered emptying of the stomach.

It seems that the various operations introduced which allow emptying of the stomach contents directly into the duodenum have been condemned without due trial. Most of the surgeons who condemn pyloroplasty have done so without any experience or after a most meagre trial of the method and many times with all the signs of a prejudged decision.

Some eminent surgeons dismiss the subject with a few kind words that are really damning so far as their influence on others is concerned. For instance, Sir Berkely Moynihan says: "The operation of Finney and the operation of Kocher have, however, a distinct place in surgery, and it is by no means unlikely that in the future they will be performed in a certain class of cases for which gastroenterostomy is now the chosen method." Warbasse, speaking of the Finney operation, says:

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"It is one of the most useful operations in surgery, and is destined to play a larger rôle than has yet been its lot." Doctor Binnie says: "Finney's operation is a most valuable contribution to surgery and in many cases it is a desirable substitute for gastroenterostomy."

Unfortunately most of the surgeons who speak so kindly of this operation go right on performing gastroenterostomies. That more do not resort to some form of pyloroplasty I believe is largely due to the fact that they are familiar with gastroenterostomy and because of a widespread but erroneous opinion that mobilization of the duodenum is extremely difficult and dangerous.

In proposing wider use of a more physiological operation for the various lesions for which gastroenterostomy is usually done I do not wish to plead for any one of the several admirable operations already well known. The Heineke-Mikulicz pyloroplasty, as usually described in the books, does not seem adequate. The opening made is too small to serve its purpose; but, as Mikulicz describes it, the procedure is more extensive. The incision is made on the stomach wall and duodenum far enough to make an adequate stoma.

The operation as done by Finney seems to meet all the requirements, and the size of the opening may be as small or large as seems necessary to meet the needs of the case. All that is necessary is to make an opening large enough to function easily after the narrowing which comes with the decrease in size of a dilated stomach. Finney and Friedenwald advise dealing with the duodenal or pyloric ulcer through the gastro-duodenostomy incision, and consider "the opportunity thus afforded to explore digitally and inspect the ulcerated area and then excise it through this incision is one of the strongest points in favor of the operation." They report 100 cases with five deaths from the following causes: (1) Persistent vomiting associated with pregnancy; (2) atrophy of the liver; (3) broncho-pneumonia in six days; (4) shock; (5) chronic nephritis (uraemia). Eighty-two cases were traced to the end of the first year and the results in 93.6 per cent. were satisfactory. Can anyone make as good a showing from an equal number of gastroenterostomies?

There are bound to be some cases where the conditions are unfavorable for pyloroplasty. Dense massive adhesions about the pylorus and duodenum will render this operation inadvisable because of the difficulties and dangers and because post-operative obstruction would be probable. Finney also excludes the cases where great thickening and infiltration about the pylorus would make the operation inadvisable. They found in most of their cases having hyperchlorhydria before operation, that the acidity gradually lessened and a normal was reached on an average of about two months.

The operation devised by Horsley, of Richmond, for its simplicity, appeals to one, if further trial shows it to be permanent in its good results. It combines resection of the ulcer with pyloroplasty which

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extends at least two inches into the stomach wall and one inch on the duodenum.

To recapitulate, the main objections to gastroenterostomy are: (1) Peristalsis carries the chyme past the gastroenterostomy opening forcibly against the pylorus, and whatever gets through the artificial stoma leaks through, following the law of least resistance. (2) The material that reaches the jejunum is much of it unprepared, chymification is incomplete, it is not yet thoroughly mixed with the gastric juice, and it is not intimately blended with the bile and pancreatic juice as is so perfectly done by the rhythmic segmentation which takes place in the duodenum. (3) Because of the facts just given, digestion is imperfect and incomplete, the intestinal mucosa is irritated and in many cases greatly inflamed, an abnormal amount of gas is present, and the patient suffers from colic, diarrhoea, and lowered nutrition. (4) Jejunal ulcer, a condition much worse than the original disease for which the operation was done, is a direct result in frequent instances of this unphysiological procedure. (5) The amount of secretin produced in the jejunum is less than normal and there is probably a subnormal amount of pancreatic secretion when all of the stomach contents enter directly into the jejunum. (6) A large meal completely filling the stomach will, as shown by Cannon and Blake, so stretch the stomach side of the gastroenterostomy stoma that the distal side of the jejunum will shut down against the opening like a lid and absolutely prevent stomach contents entering the jejunum.

Pyloroplasty or gastroenterostomy does not have these objections, but has the advantage of permitting the digestion to go on normally. The opening is in the regular highway of the peristaltic wave. Even when the sphincteric action of the pylorus is destroyed the rhythmic segmentation of the powerful duodenum will prevent the stomach from emptying too rapidly. Later, if the pyloroplasty has not been made too large, the pyloric sphincter will function to a certain degree on the same principle that the anal sphincter acts after it has been cut.

It seems to me that a great improvement in results will be obtained when a universally friendly co-operation is established between the internist and the surgeon. Too often a spirit of rivalry has entered in and the controversies have sometimes been a little acrimonious. In gastric and duodenal ulcers there is a distinct place for the internist and for the surgeon.

When one of these cases falls into the hands of an internist it would seem only fair for him to appreciate that this is a borderline case and call in a surgeon in order that the patient may have the advantage of both viewpoints; and the surgeon should not operate on one of these cases without the benefit of a good, clear-headed internist's advice and counsel.

Each case ought to be worked out carefully from all angles, a good anamnesis secured, the clinical symptoms weighed carefully, the physical signs gone into thoroughly, the chemical and X-ray findings consid-

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ered in an unbiased manner, a Wassermann test made in every case, and the patient's general condition and resistance sized up as fully as possible. If further medical treatment is deemed advisable, always considering the welfare of the patient first, let that be done, and if the treatment succeeds, so much the better. If no benefit is derived from medical treatment or if the symptoms recur, surgery should have its innings. And when an operation is done it is a great comfort to have a friendly and resourceful internist at one's elbow and let the type of operation be worked out together.

When an operation on the stomach is begun it should stop short so far as the stomach is concerned unless real pathology is found. Failing to find the expected gastric or duodenal lesion a thorough survey of the intraabdominal viscera will often be rewarded by finding some unexpected pathology which explains the symptoms.

It is my opinion that active ulcers are better dealt with by excision or, better still, by cauterization, as so admirably worked out by Balfour. It is also important, when operating on ulcers, to find and remove the focus of infection from which the ulcers had their origin. The gallbladder and appendix are always under suspicion and no operation is complete until these organs have been inspected carefully and removed unless normal.

One of the sins to which too many of us must plead guilty is operating on these patients and turning them loose. In these chronic cases the operation is only the first step in the cure. Every case should be treated carefully, medically and dietetically for months and often for years, before being considered cured in the sense that he may be permitted to go along and live and eat in his own way without medical guidance.

I am convinced that if these cases are systematically studied post-operatively from the standpoint of symptoms, chemistry, and X-ray findings, the knowledge gained will be illuminating. Many of the so-called successes will be disappointing, especially if the follow-up system is carried out over a series of years. That type of operation will be adopted in the final chapter that leaves the stomach mechanically and physiologically in the most normal condition.

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## DRAINAGE OF THE COMMON BILE DUCT THROUGH THE CYSTIC DUCT: CYSTICO-CHOLEDOCHOSTOMY

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TWELVE months ago Doctor Halsted and I made a brief report at a meeting of the Medical Society of the Johns Hopkins Hospital on the subject of drainage of the common bile duct. Up to that time the ductus choledochus had in four instances been drained in the manner about to be described, two of the patients being exhibited at the meeting. In a letter to the editors of the *Journal of the American Medical Association* (published December 20, 1919, vol. lxxiii, pp. 1896 and 1897) Doctor Halsted advocated the careful and complete closure of the incision into the choledochus and the drainage of this duct by a tube passed well into it by way of the ductus cysticus. For this procedure he proposes the term cystico-choledochostomy, realizing, of course, that the choledochotomy is not embraced in it.

In our older hospital records we find that in a few instances a tube had been passed from the cystic into the common duct, but only in cases in which the common duct had not been incised. For example, in 1899, Doctor Halsted being able to remove stones from the common bile duct by forcing them back through the cystic duct drained the former by a tube passed through the latter. Similarly Sowers, in 1904, drained the common duct through the short stump of a friable cystic duct. Finney and Follis, also for the same obvious reason, drained the common duct in this manner in 1903 and 1904. In none of these cases, however, had the common duct been incised.

On March 24, 1917, Doctor Halsted first employed the method that we now advocate for all cases in which there is no definite contraindication. The patient, a woman fifty-six years old, was intensely jaundiced. After the removal of a shrunken, chronically inflamed gall-bladder containing stones, and of several large, soft stones through an incision into the greatly dilated common duct, there remained one rather large stone wedged in the mouth of the cystic duct. As this stone was not readily removed by instruments it was dislodged with the fingers of the operator, the little finger of the left hand being inserted into the dilated cystic duct and the right index finger into the common duct. On dislodgment of the stone the little finger slipped easily through the cystic into the common duct. A catheter, No. 19, French, was passed through the cystic into the common duct and retained by a suture of catgut, No. 00. The long incision in the common duct was carefully closed with two rows of interrupted

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chromic catgut (No. 0) sutures. About this tube four small drains<sup>1</sup> were placed. The patient's convalescence was remarkably rapid. All of the drained bile came by way of the tube and thus could be accurately measured (Vid. Chart No. 3, Case I). On the fourth day the tube was clamped for eleven hours; on the fifth for a longer period. As the clamping caused the patient no distress, and as there was no peritubal leakage, the tube was removed on the sixth day. Except for a faint stain on the first dressing there was no evidence thereafter of even a drop of bile in the sinus tract. The wound healed promptly and the patient walked out from the hospital three weeks after admission. Thus for the first time in this clinic drainage of a sutured choledochus was maintained by a tube passed into it through the ductus cysticus. In the previous cases of cystico-choledochostomy the common duct, as stated above, was not incised, the stones having been removed through the cystic duct.

Although the impression made by this experience was a profound one, it was not until Doctor Halsted, two and a half years later, had been operated upon for stones in the common duct and experienced the distressing consequences of the loss of all the bile for a period of three weeks that he insisted upon the closure of the incision into the choledochus and the drainage of this duct by way of the cysticus whenever possible. He had, indeed, requested that this procedure be adopted in his case, but as the cystic duct entered the common duct from behind it was thought better, being simpler, to drain the choledochus in the orthodox fashion—in the way recommended and practiced by surgeons the world over. On the second day bile began to leak about the tube and after the fourth day the tube (removed on the fifth day) conveyed none of the bile which for three weeks poured in great quantity from the sinus. Food was positively repulsive, and the sense of taste was so far lost that frequently he seemed unable to distinguish one kind of food, meat or vegetable, from another except by sight. By the fourteenth day emaciation and weakness were so marked that grave concern for his life was felt. In three weeks he lost thirty pounds in weight.

The operation is performed as follows:

The cystic and common ducts being well exposed, the cystic artery ligated, the cystic duct clamped and divided about 2 cm. from

<sup>1</sup> The drains employed in this case are made as follows: A single layer of gauze of the required size is laid upon a piece of gutta-percha protective cut to a slightly larger size; the two are then rolled or folded up together, the gauze being on the outside and the protective projecting beyond it. The protective prevents granulations from penetrating the drain deeper than one layer of gauze. Drains of this kind are used, not infrequently, instead of the cigarette drains to guard against their possible displacement. Cigarette drains may, of course, be anchored by the gauze which projects from the ends, but Doctor Halsted believes that it may sometimes be better to have the protective project in order to avoid the adhesion of gauze to the line of suture in the common duct or to the tissues about or over the stitches. Drains such as above described are loosely anchored by adhesions throughout their length—everywhere except at their very tips.

its origin, the gall-bladder excised, the common duct incised, and all discoverable stones removed, a probe as large as possible should be passed into the duodenum. The stump of the cystic duct should then be investigated and, if advisable, stretched by a clamp or other instrument (Vid. Fig. 1). It is my preference to introduce the tube

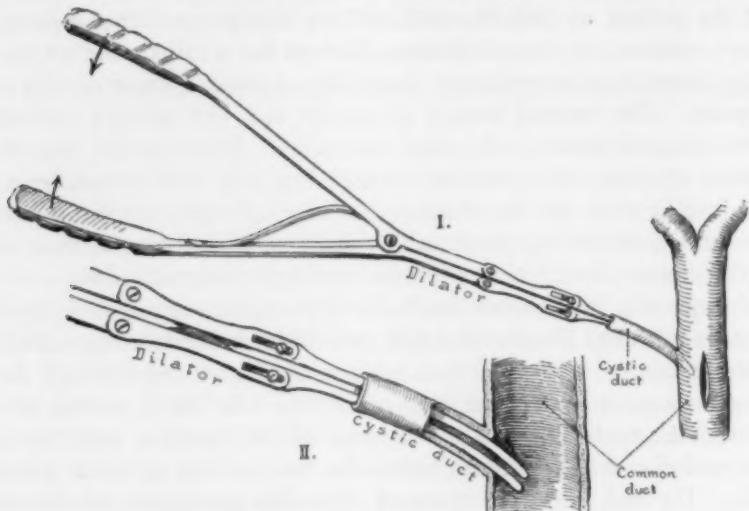


FIG. 1.—Showing a method of dilating the cystic duct.

of the selected size through the cystic into the common duct before suturing the incision into the latter (Vid. Fig. 2). The tube being

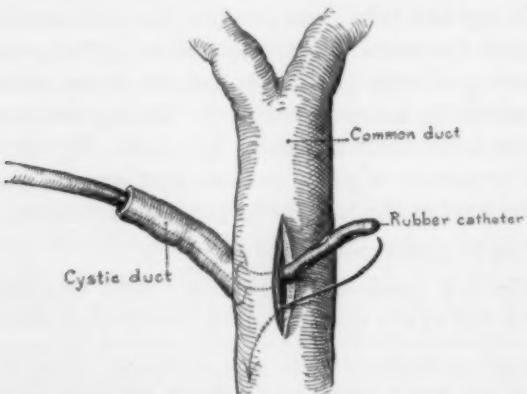


FIG. 2.—The small side openings are made in the catheter after it has been introduced through the cystic duct and pulled out of the opening in the common duct. It is then returned to the common duct and anchored to the cystic duct before the incision of the common duct is closed. In this way one assures the final position of the end of the catheter.

properly located, it is maintained in place by one stitch of catgut No. 00, passed through its side and into the wall of the cystic duct. The incision into the choledochus is closed by one or, preferably, two rows of interrupted fine silk (No. 0) sutures. I have several times

## CYSTICO-CHOLEDOCHOSTOMY

used the finest catgut (interrupted sutures) for the inner row. One should test the line of suture by injecting salt solution through the tube. The suture line may then be protected from the drains by overlaid fat or other tissue. Three or four very thin Halsted drains or slender cigarette<sup>2</sup> drains are placed about the rubber catheter. The cystic duct should be made to hug the catheter closely. It may ultimately seem advisable to employ a tube larger than we have been accustomed to use, but we must bear in mind the fact that the chief function of the tube is to relieve tension on the line of suture of the common duct until union of this wound is firm. The employment of the largest possible size of tube in the unjustified hope that perhaps a stone may escape through it is inadvisable. Although small concretions have occasionally been known to pass by way of a tube, it is more than probable that when this has occurred others

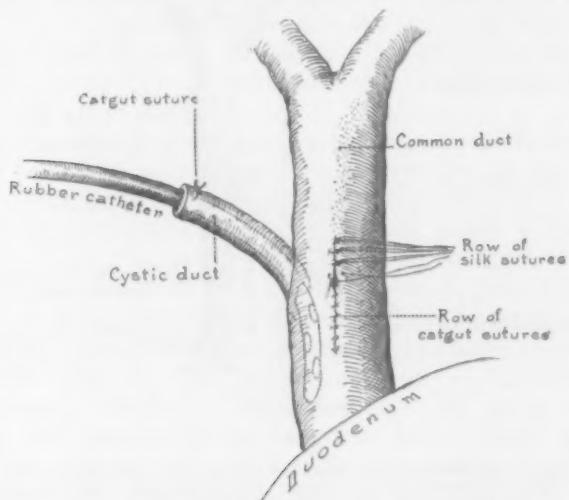


FIG. 3.—Cystico-choledochostomy completed except for the second row of sutures in the common duct.

were left to find their way into the duodenum by the natural route. In none of the experiments on suturing of the common duct made by Doctor Halsted and myself have we seen a suture making its way into the duct. The little knots of black silk were invariably found outside. Sutures may, conceivably, have been cast off into the lumen, but if so they had passed into the duodenum before the animal was sacrificed. In one of Doctor Halsted's dogs the wall of the duct was so far inverted as to produce intense jaundice for a number of days. When, on recovery, the dog's common duct was examined its lumen was at no point found to be narrowed.

The abdominal wound is closed, layerwise, by sutures of silk No. A (doubled for the rectus sheath) reinforced by two or three through-and-through stitches of silkworm gut. The drains are re-

<sup>2</sup> The cigarette drains were also devised by Doctor Halsted, who in the early eighties inaugurated the use of gutta-percha tissue (Vid. J. Am. M. Assn., 1913, ix, p. 1119).

moved, some on the second or third day, the remainder on the third, fourth or fifth day. The catheter in the duct should not be disturbed until there is reason to believe that the wound in the common duct is firmly healed. In one instance it was left, as an experiment, for three weeks. Observations of various kinds, detailed below, were made during this period. On removal of the tube the bile, except for a few cubic centimetres, passed by the natural route.

In case of obliteration of the cystic duct one should make, if feasible, a second opening in the choledochus, just large enough to admit a small tube, and completely close the original incision. I tested this in one case at Doctor Halsted's suggestion, and with satisfactory result. The outflow of bile ceased promptly on withdrawal of the tube (Vid. Fig. 4).

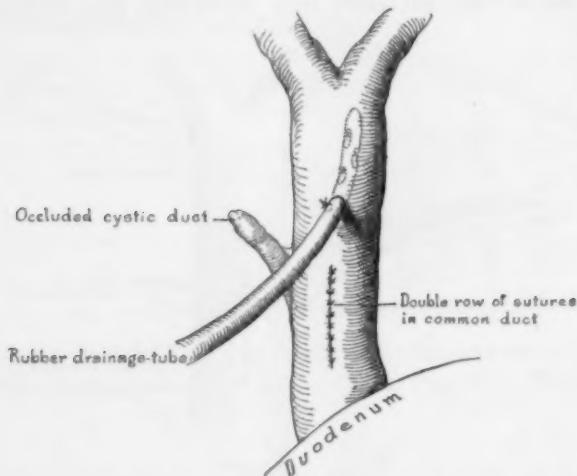


FIG. 4.—A method of avoiding the placing of a tube through the incision of the common duct when a cystico-choledochostomy cannot be done.

That the operation may occasionally be difficult or even impossible must be admitted. The obliteration of the cystic duct in one of my cases prevented its accomplishment. Whereas tubes passed through an incision into the common duct seem, as a rule, less liable to kink if they are passed upwards, towards the hilum of the liver, the natural direction for those introduced through the cystic duct seems to be downwards, towards the duodenum. In all of our cases the tube has been pointed towards Vater's diverticulum, and in none of these did it become kinked or obstructed. The curve of the tube is probably supported by the cystic duct and the under surface of the liver, so that I believe kinking is really less likely to occur than when the tube is directed upward through an incision in the common duct. There is great variation in the size of the cystic duct. When it is too small to admit a tube of the required size it should be dilated with either a fine clamp or special instrument (Vid. Fig. 1). I have found that it can be readily stretched. The tube which

## CYSTICO-CHOLEDOCHOSTOMY

we have usually employed has been a catheter, size No. 16 of the French scale, but a No. 12 suffices. The tube should be snugly embraced by the cystic duct which if too large should be reduced in size by a stitch or two. Occasionally one may have to split the duct for a short distance to facilitate the introduction of the stretcher.

The following four cases are cited to illustrate the value of this method of draining the common bile duct after choledochotomy.

**CASE I.**—Surg. No. 42375. Admitted March 22, 1917. Female, white, aged fifty-six years. For twenty years the patient suffered from indigestion; only for the past five months has she been jaundiced.

*Examination.*—Intense jaundice of a slightly greenish hue; stools clay colored; temperature normal; blood negative; systolic blood-pressure, 140; diastolic, 80; slight tenderness on deep pressure over the common duct; an indefinite mass in the region of the gall-bladder.

*Operation* (March 23rd, by Doctor Halsted).—Cholecystectomy, choledochotomy, cystico-choledochostomy. The details of the operation have been given above.

No bile appeared in the wound after the removal of the tube; the abdominal incision was completely healed seventeen days after the operation. The daily drainage of bile is tabulated in Chart No. 3, Case I. *Bacillus coli* was the only organism found in the cultures.

**CASE II.**—Surg. No. 51586. Admitted July 29, 1920. Male, white, aged sixty-three years. In the seventy-five days preceding patient's admission to the hospital he had five attacks of chills, fever and severe, colicky pains; with each attack the jaundice deepened.

*Operation* (July 30, 1920, by Doctor Reid).—Cholecystectomy, choledochotomy, cystico-choledochostomy. A large stone was wedged in the ampulla of the common duct. After dilating the cystic duct a catheter, No. 12, French, was passed through it into the common duct. The incision into the common duct was closed with two rows of interrupted sutures—the first of catgut, the second of silk.

There was no leakage at any time of bile about the tube which was removed on the sixth day; there was slight drainage of bile through the wound for two days (Chart No. 3, Case II). *Bacillus coli* was the only organism found in the cultures. The patient was discharged with the wound healed twenty-three days after the operation.

**CASE III.**—Surg. No. 52024. Admitted September 25, 1920. Female, white, aged forty years. Typical attacks of gall-stone colic associated with jaundice and fever began only two months before admission.

*Examination.*—Patient is deeply jaundiced. There are numerous skin abrasions, and furuncles, the result of scratching to relieve the itching.

*Operation* (September 29, 1920, by Doctor Reid).—Cholecystectomy, choledochotomy, cystico-choledochostomy. The gall-bladder and common duct were filled with stones. After excision of the

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gall-bladder the common duct was incised and from it about thirty stones were removed. A No. 14 catheter was passed through the large cystic into the common duct. The lumen of the cystic duct had to be reduced to the size of the tube by the application of two silk sutures.

For the first two or three days the bile from the tube was thick and very dark. On the fifth day it appeared to be normal and the tube was then clamped for three hours. The occlusion of the tube was followed by pain and nausea. It was not clamped on the sixth day. On the seventh day the clamping of the tube produced no noticeable symptoms, and hence it was withdrawn. The drainage of bile externally ceased on the ninth day—two days after the withdrawal of the tube (Vid. Chart 3, Case III). For the seven days prior to the tube's removal the patient had no appetite and protested against efforts made to feed her. In addition to the anorexia there was marked lethargy. The appetite returned promptly on restoration of the bile to the intestine.

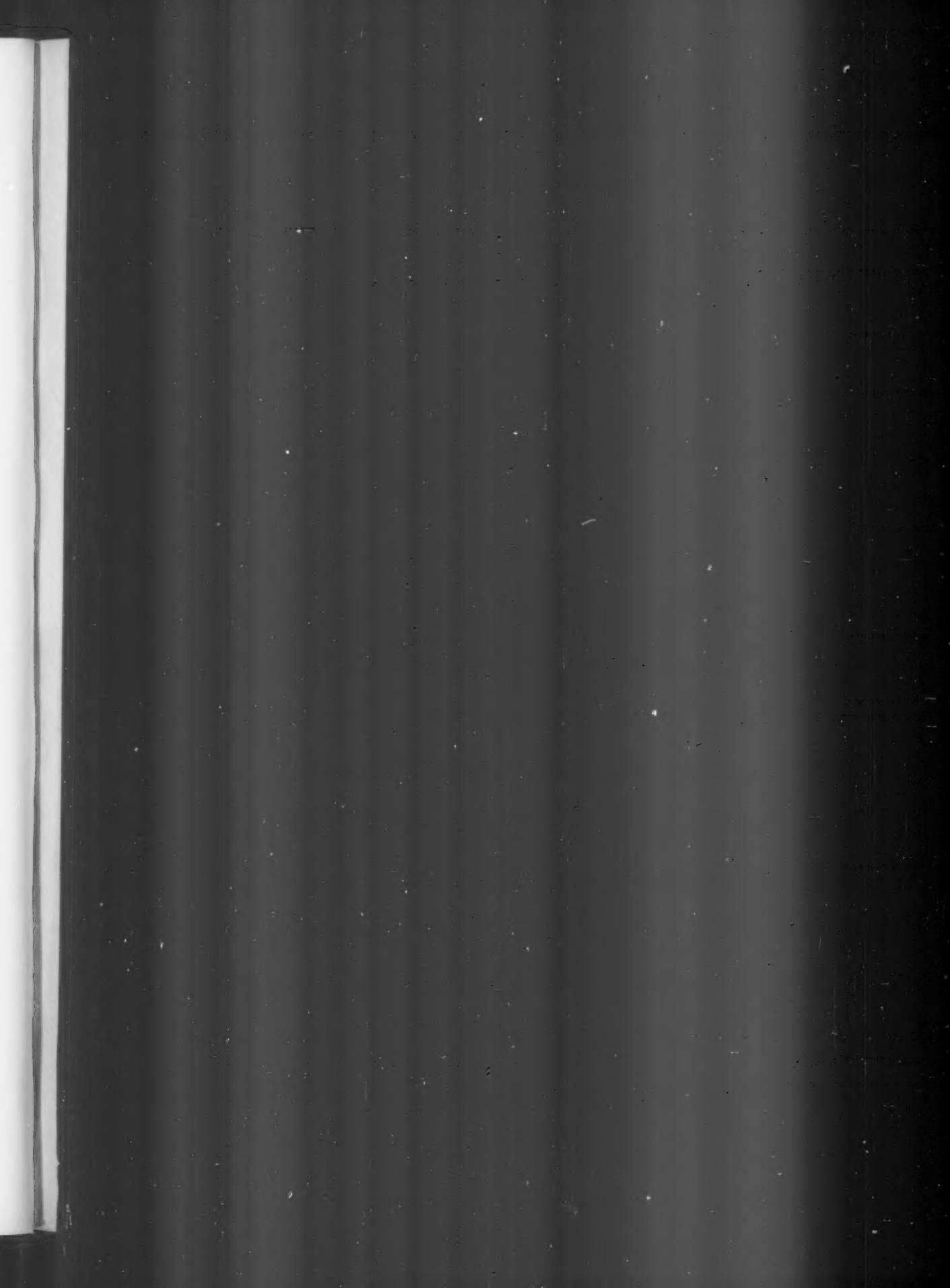
The wound was completely healed fifteen days after the operation, and the patient left the hospital on the twenty-third day.

CASE IV.—Surg. No. 52206. Admitted October 11, 1920. Female, white, aged forty-six years. Patient gave an indefinite history of pain in the region of the gall-bladder and of brief periods of jaundice during the six years prior to admission.

*Operation* (October 18, 1920, by Doctor Reid).—Cholecystectomy, choledochotomy, cystico-choledochostomy. The liver was found to extend far below the costal margin. A large pedunculated lobe overhung the gall-bladder. The narrow pedicle of this lobe consisted chiefly of dense, fibrous tissue. The constriction was manifestly due to tight lacing. A thickened gall-bladder bound by adhesions was excised. An exploratory incision was made into the common duct, but no stones were found. The cystic duct admitted a small probe and was easily dilated to accommodate the No. 12 catheter which was pushed through into the choledochus. The incision into the common duct was carefully closed with two rows of fine silk sutures, and the efficacy of the closure tested by injecting salt solution through the tube.

This patient had slight nausea and vomited occasionally for the first eight days. These symptoms were not accentuated by the clamping of the tube on the fifth, seventh and eighth days (Vid. Chart No. 3, Case IV). After the ninth day the tube was kept occluded most of the time until its removal on the nineteenth day. During all this period no bile escaped externally except by the tube. The tube was left undisturbed for this length of time to afford opportunity for observations on the rate of the flow of bile under various conditions and to note the bile pressures (Vid. Charts 1, 2 and 3).

The first recorded observation was made on the tenth day after operation when the patient had a good appetite and no discomforts and when all the bile was passing into the duodenum. In none of



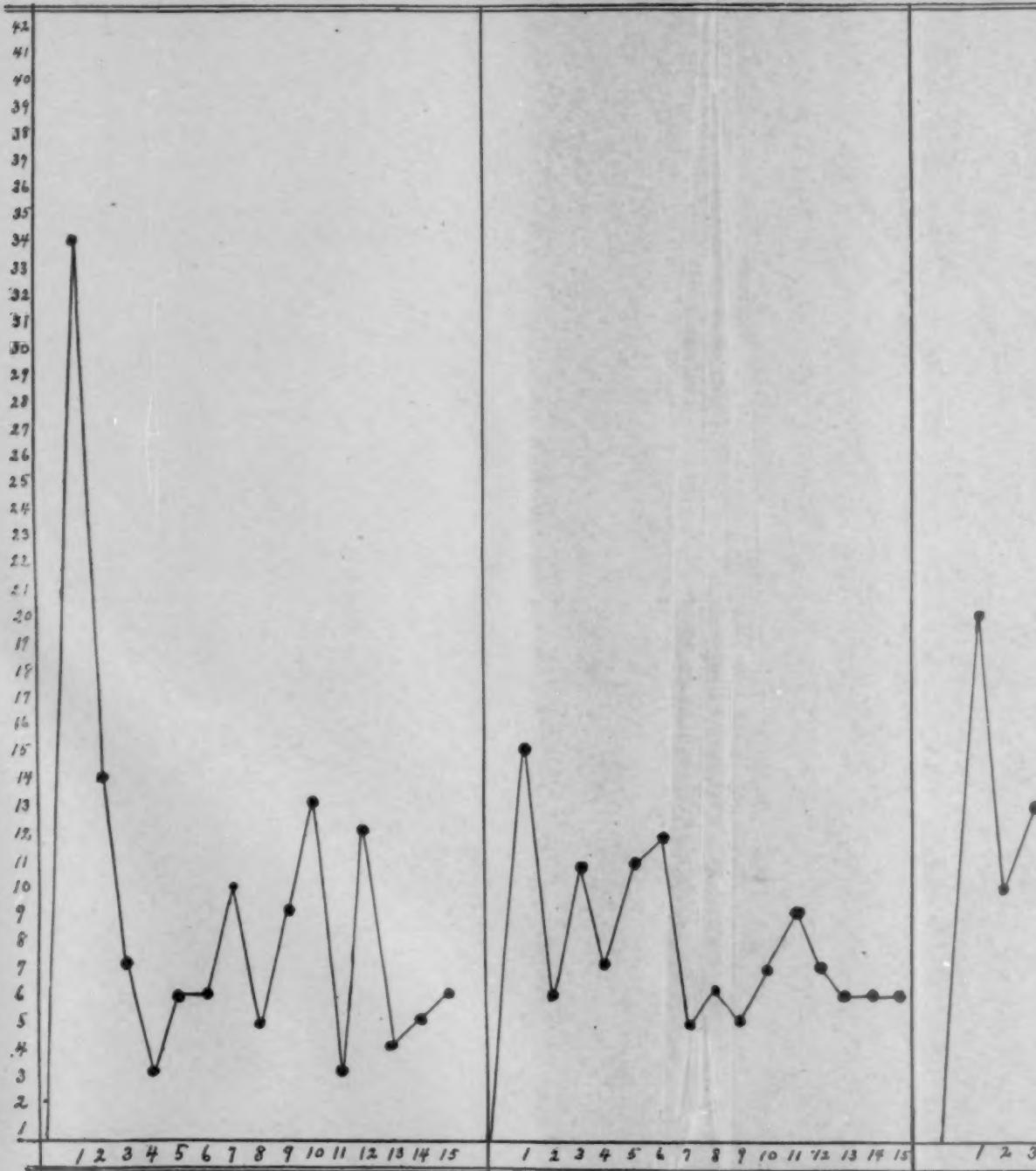
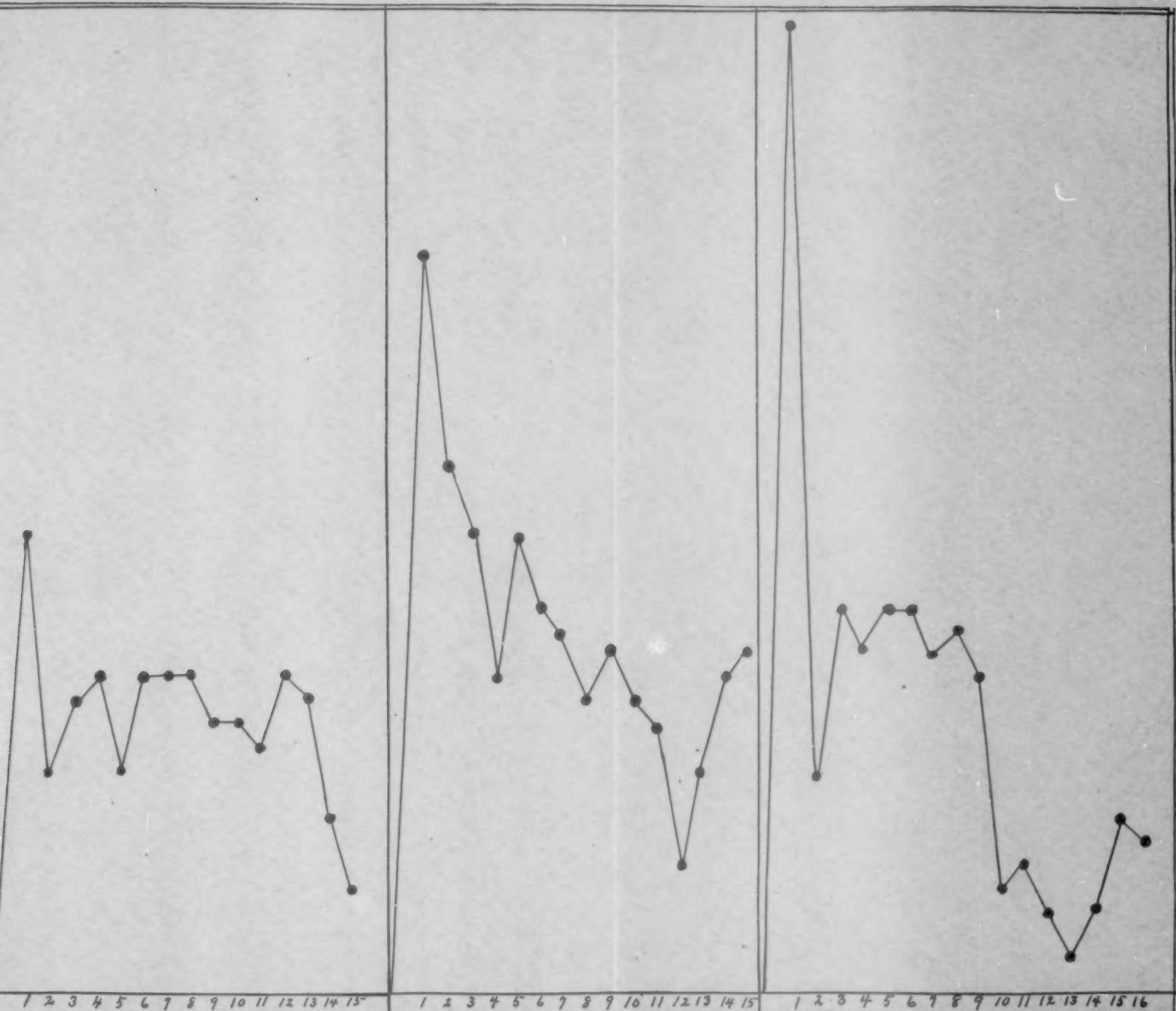


CHART No. 1.—THE RATE PER MINUTE OF FLOW OF BILE FROM

CASE IV.—Observation No. 1. Oct. 28, 1920, 6 P.M.  
After the tube had been occluded for three hours.

CASE IV.—Observation No. 2. Oct. 29, 1920, 11.45  
A.M. After the tube had been occluded for four hours.

CASE IV.—  
After the



#### EXCRETION FROM THE TUBE, FOR FIFTEEN MINUTES FOLLOWING VARIOUS PERIODS OF ITS OCCLUSION

CASE IV.—Observation No. 3. Oct. 30, 1920, 4 P.M.  
After the tube had been occluded for sixteen hours.

CASE IV.—Observation No. 4. Oct. 31, 1920, 5.20 P.M.  
After the tube had been occluded for twenty-five hours.

CASE IV.—Observation No. 5. Nov. 1, 1920, 8.30 P.M.  
After the tube had been occluded for twenty-seven hours.



## CYSTICO-CHOLEDOCHOSTOMY

our observations was the bile outflow continuous for more than a minute after the unclamping. During the interrupted flow three or more drops would follow closely and then, for a few seconds, there would be none. These observations seem to support the assumption that rhythmical waves of contraction, similar to those of the ureter, occur in the common bile duct.

In addition to the kymographic record of the dripping of bile from the tube we have observations (made by Doctor Webster) on the bile pressure (Vid. Chart No. 2). On the nineteenth day after the operation the tube in the cystic and common ducts was connected with a manometer. The "U" was filled to the level of the short arm with bile and this level, being approximately on the level with the common duct, was considered as being zero pressure.

Connection with the manometer was made at 8.15 P.M. The bile in the long arm of the "U" started rising immediately and by 8.20 had reached a height of 6 cm. and by 8.22 a height of 8.5 cm. This rise occurred stepwise, the pressure rising during the act of inspiration and remaining stationary or dropping back slightly with expiration. By 8.25 the pressure was 9.25 cm. During this time the patient was lying quietly relaxed, at one time only speaking a sentence of five words. The breathing was perfectly quiet. At 8.27 P.M. the pressure level was fluctuating between 9.5 and 9.75 cm., being highest at inspiration. Shortly after 8.27 the patient took a fairly deep sigh when the pressure rose to 10.25 cm. By 8.30 the pressure had dropped back to 9 cm. At this point we asked the patient to raise her arms to her head, whereupon the pressure rose to 9.5 cm. On putting both arms down by her side the pressure dropped to 8.5 cm., but soon rose to 9 cm., falling to 8 cm. by 8.33 P.M. The patient now was asked to move the left leg. This was followed by the bile pressure rising to 9.25 cm. The pressure remained at this level until 8.35 P.M. We then asked the patient to hold her breath for ten seconds; the pressure rose to 13.5 cm. and then went back to 7.75 cm. Upon holding the breath for twenty-five seconds the pressure rose to 16.5 cm. and then dropped to between 11 and 12 cm. At 8.37½ P.M. the patient spoke a few words; the pressure rose to 14 cm. At 8.40 P.M. the pressure began dropping by steps (going down on expiration and remaining at that level or rising slightly on inspiration) until it had reached 10 cm. Between 8.41 P.M. and 8.43 P.M. the pressure fluctuated between 8 cm. and 7.5 cm. When the patient yawned the pressure went at once to 10 cm. and dropped immediately to 6.5 cm. On holding her breath for fifteen seconds the pressure rose to 10 cm. and then dropped to 7 cm. Twenty seconds after this the patient held her breath for twenty seconds and the pressure rose to 10.5 cm. It then dropped to 7 cm., but on yawning it rose to 11 cm.

By pressing with the hand on the abdomen in the lower left quadrant the pressure rose in the manometer corresponding with the amount of pressure made on the abdomen. It was possible, with extreme pressure on the abdomen, to obtain a pressure in the manometer of 17.5 cm. (Vid. Chart No. 2).

*Advantages of Cystico-choledochostomy.*—(1) The incision into the common bile duct may be closed completely and with confidence that union by first intention will usually be secured. The presence of a tube led through an incision into an infected duct undoubtedly imperils the healing of that incision. In many such cases the wound of the duct probably breaks down throughout its entire length. With the opening of the incision into the choledochus the bile leaks about the tube. On extrusion or removal of the tube the bile drains through the abdominal wound until the opening in the duct becomes closed by granulation tissue or healing by second intention. In relatively young and healthy individuals the processes of repair may be rapid, and the loss of bile may be sustained occasionally for long periods without serious consequences. But in debilitated or old people the complete loss of bile may in a few weeks prove disastrous. Emaciation and weakness due to the loss of bile have presumably predisposed some of our patients to the pneumonias of which they died and have occasioned great distress to many of those who recovered.

(2) Healing of the abdominal wound and drainage tract is less likely to be delayed if uncomplicated by the leakage of bile—bile which is quite invariably infected.

(3) The period of bile drainage may be shortened by weeks. On the third or fourth day one might begin to test the effect of clamping the tube, but I believe it may be dangerous so early to expose the common duct sutures to the possible pressure from within the duct. In one case there was obstruction, presumably at the papilla, for five days. It would seem to be advisable to delay the clamping of the tube when the common duct is seriously infected.

The effect of the first occlusion of the drainage tube should be noted carefully. After one to three hours the patient may complain of pain and possibly vomit. We interpret these symptoms to mean that the bile is finding difficulty in passing into the duodenum and is collecting under pressure in the common duct: consequently we unclamp the tube. The release may be followed by a rather profuse flow of bile for a few minutes. Several brief trial occlusions of the tube may be necessary before evidence that the bile has made its way into the duodenum is furnished. When the occlusion of the tube is not followed by pain or gastric disturbance we assume that the flow of bile is unobstructed. In one case the tube was left in place for three weeks, the occlusion being maintained continuously for sixteen days, except for occasional brief interruptions to permit observations on the bile pressure and flow.

(4) Following removal of the cystico-choledochostomy tube there has been no leakage whatever of bile in more than half the cases, and no patient has drained externally a significant amount of bile for more than two days.

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(5) When there is a serious infection of the bile ducts it might seem advisable to embrace the opportunity which the snugly fitting tube affords to irrigate the ducts with very mild antiseptic solutions.

(6) The technic of cystico-choledochostomy or some modification of it may afford a means of releasing gradually the bile pressure in the biliary apparatus.<sup>8</sup>

### SUMMARY

1. Prolonged leakage of bile is distressing in its consequences to those who withstand it and has occasionally, both directly and indirectly, been responsible for the death of the patient.
2. The incision into the common duct should be closed and the tension on the suture line be relieved by a tube passed through the cystic duct.
3. This tube, if properly fitted, may function for weeks, conveying the bile, without peritubal leakage, to the surface.
4. On removal of the tube the discharge of bile through the fistula ceases either immediately or within a day or two, provided the common duct is not obstructed.
5. The patency of the duct may and should be tested by clamping the tube.

<sup>8</sup> I have frequently observed that the drainage of the common bile duct of deeply jaundiced patients is followed by a serious toxic state characterized by listlessness, normal or subnormal temperature, and a tendency to sleep. In an extreme case it may be difficult to arouse the patient. I have not seen this toxic state in non-jaundiced patients, and it would seem, therefore, to be due not merely to the loss of bile, but rather to the effect of the release of the bile pressure. The same effects have been noted when deeply jaundiced patients were relieved of their bile pressure by anastomosing the gall-bladder to the stomach or intestine.

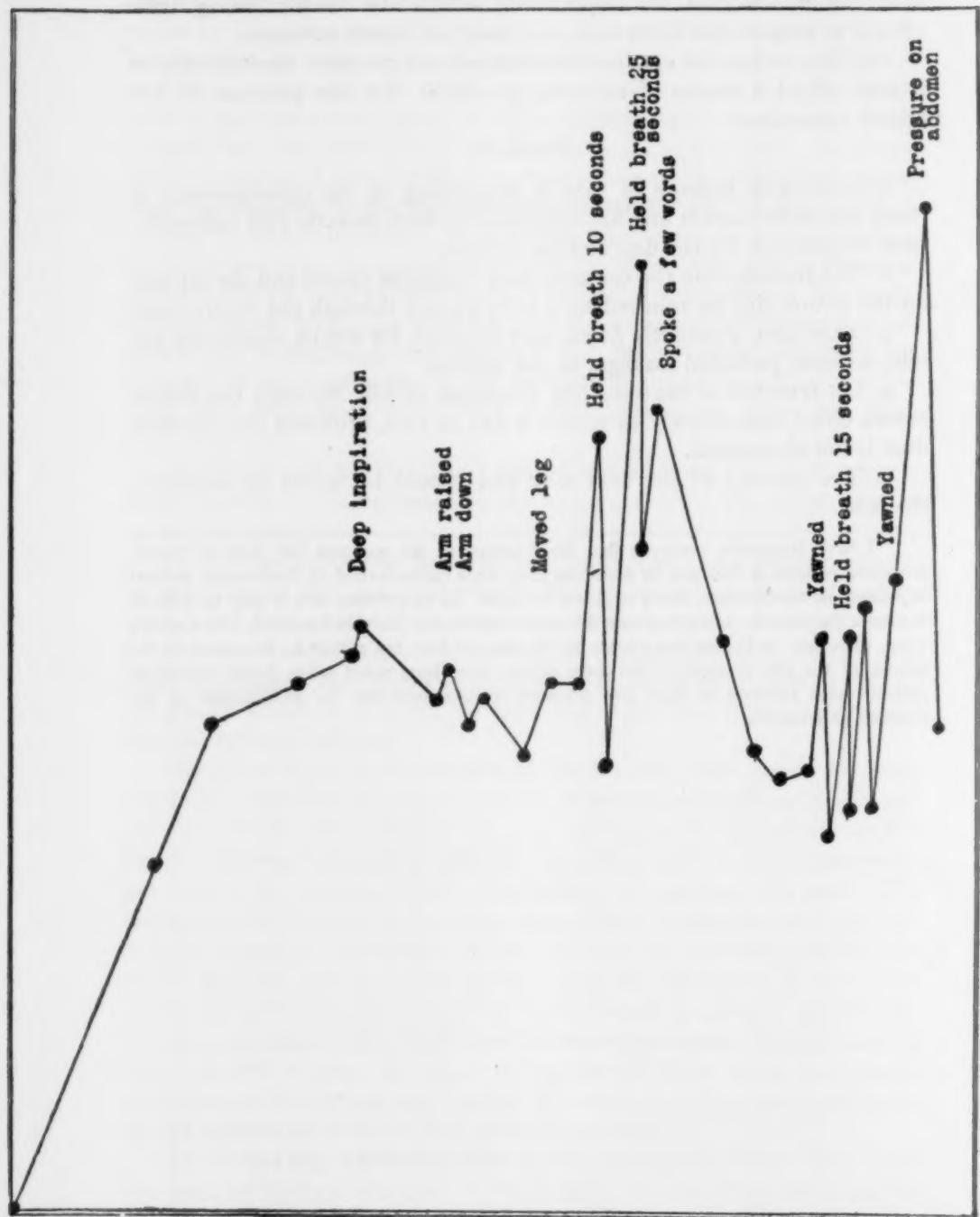


CHART 2. CASE IV.—OBSERVATIONS ON THE BILE PRESSURE. PRESSURE RECORDED IN CENTIMETRES OF APPARENTLY NORMAL BILE

## CYSTICO-CHOLEDOCHOSTOMY

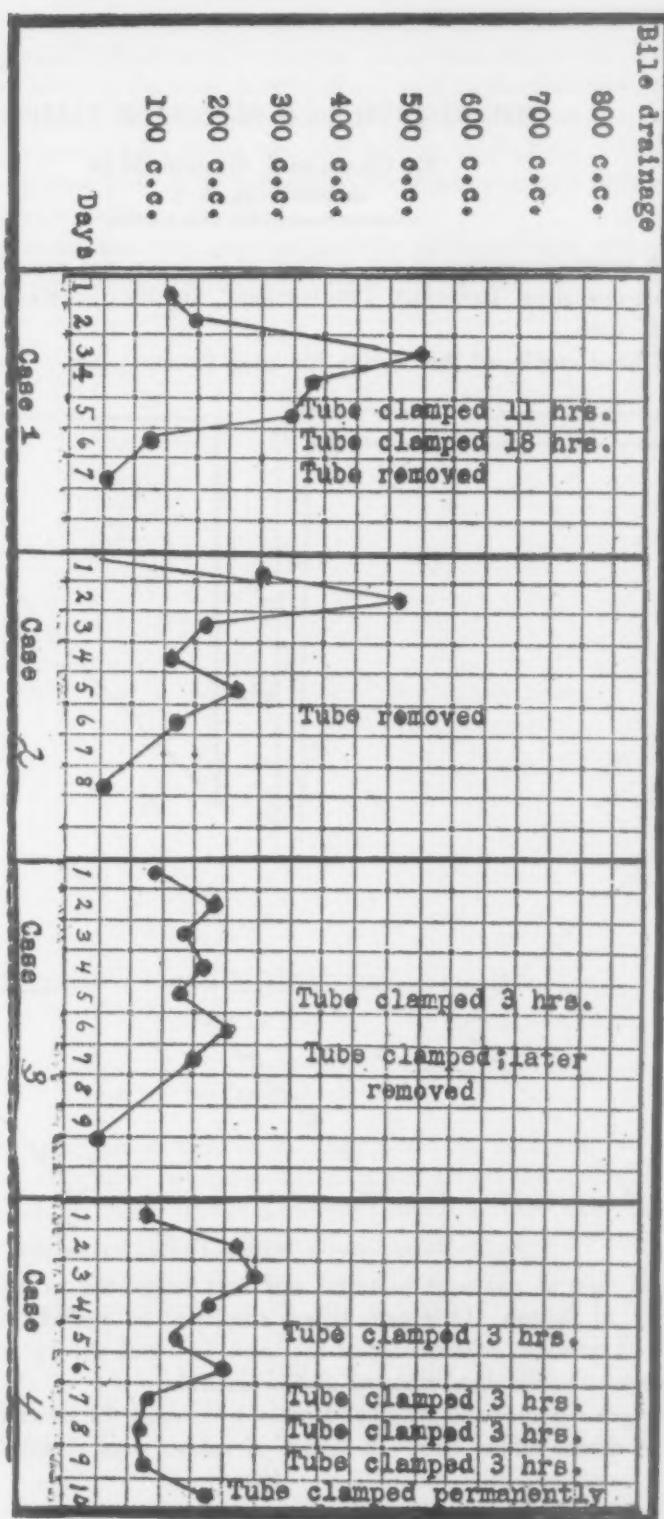


CHART No. 3.—BILE DRAINAGE CHARTED FOR THE FOUR CASES REPORTED IN THIS PAPER

Case No. I was unaffected by the clamping of the tube, and there was no leakage of bile after its removal. In Case II preliminary clamping of the tube was not done. After its removal on the sixth day some bile drained from the wound for two days. In Case III the clamping of the tube on the fifth day for three hours was followed by pain and vomiting. Its removal on the seventh day was followed by a little leakage of bile for two days. In Case V it is questionable whether some nausea and vomiting on the fifth and eighth days have any relation to the clamping of the tube, for they were present before this was done. On the ninth day there were no symptoms either before or after the clamping. On the tenth day the tube was clamped, and remained so, except for short periods (Vid. Chart 1), until the twentieth day, when the tube was withdrawn. There was no leakage of bile after its removal.

## THE RUBBER DAM MIKULICZ TAMпон

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A BRIEF description of this method of drainage was made in my article on "Post-operative Intestinal Obstruction" in the ANNALS OF SURGERY, April, 1916.

I have employed this device for over twenty years. The use of dental

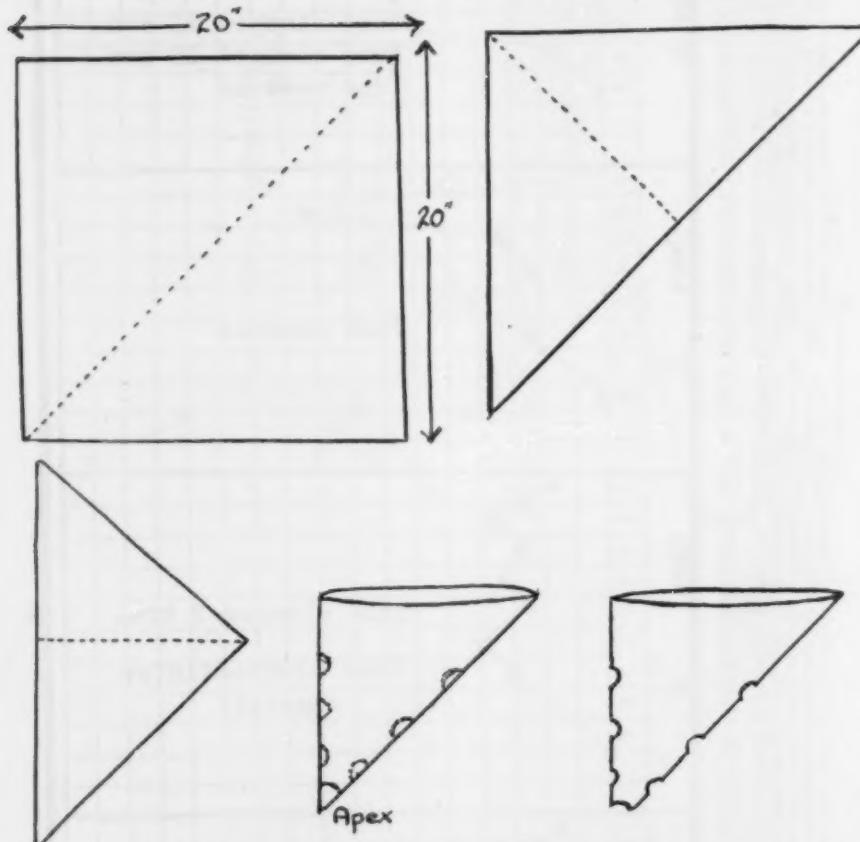


FIG. 1.—Diagrams showing folding and cutting of rubber dam.

rubber dam as drainage material was first suggested to me by Dr. C. A. Porter, of Boston. Originally it was employed by him and by me in certain cases of cellulitis, particularly of the hand, in which the use of gauze packing possesses obvious disadvantages and is painful.

I have modified the Mikulicz tampon by making the outer enveloping layer out of dental rubber dam. A square of rubber dam of suitable size, say 20

### THE RUBBER DAM MIKULICZ TAMPON

by 20 inches in the case of a large retrocecal appendiceal abscess, is folded two or three times in the form of a cornucopia. The apex, which will eventually be the lowest point of the dam, is snipped off, making the hole the size of the little finger. An inch and a half above this the edges of the cornucopia are cut out, making a perforation about one-half inch in size (Figs. 1 and 2). In some cases a second row of perforations is cut about one inch higher up. The tampon is then introduced as follows:

After the appendix has been removed and the cavity sponged out of all purulent material and blood, the operator carries the tampon into the cavity,

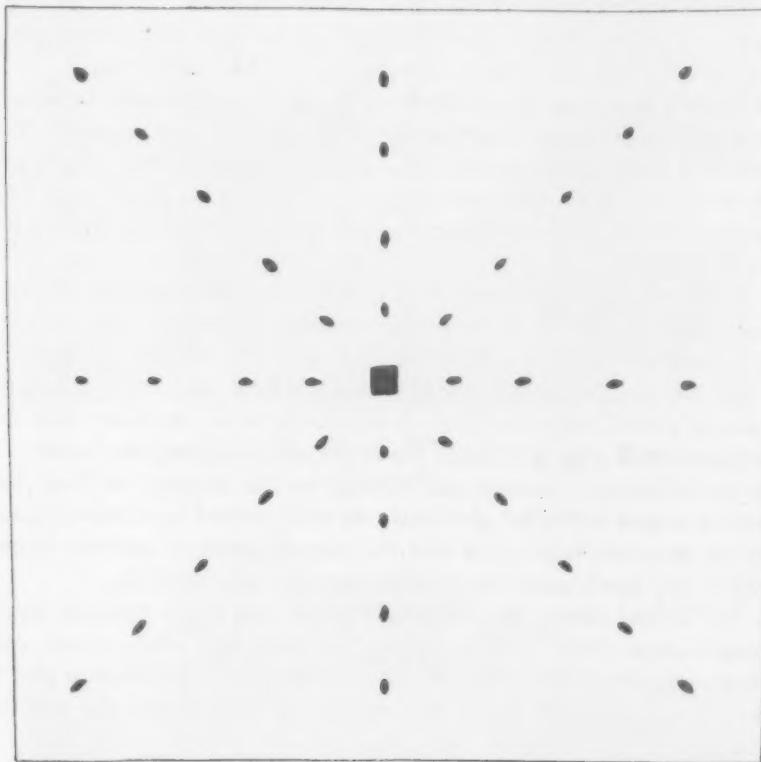


FIG. 2.—Showing distribution of holes.

the index finger being placed at its apex (Fig. 3). The pads and retractors are still in place. The edges of the rubber dam are spread out and while the operator still keeps his finger on the apex, the tampon is filled with strips of packing. I generally "overstuff" the cavity in order to push the omentum and gut well away from the incision in the abdominal wall (Figs. 4 and 5). A large loose dressing is applied. At the end of twenty-four hours the outer dressing is removed. The tampon is usually not disturbed that day, although the gauze packing may be partially withdrawn in order to allow a little better drainage by loosening the dressing. At the end of another forty-eight hours the gauze is all removed. Then one of two things may be done; either the

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tampon is also removed or it is left in place and a small amount of fresh gauze reintroduced. At the end of seventy-two hours the original tampon should be entirely removed. By that time the rubber dam will have become quite smelly.

At this period one of the principal advantages of using the tampon will have been obtained; namely, the permanent pushing back of the abdominal contents from the wound cavity, and there is now left a well-defined, walled-off cavity which can be drained with great ease. There is, moreover, no longer need for the free "wide-open" drainage, and the cavity can be drained by inserting a small piece of rubber dam folded on itself two or three times. This piece of rubber dam is generally removed in the course of a day or two, and the Carrel-Dakin treatment instituted under ideal conditions.

An abscess treated as described above drains in a marvellous fashion. The fluid readily escapes both alongside the rubber dam and by capillary drainage through the loosely packed gauze. The intraabdominal contents are kept back with a minimum of trauma and irritation. The removal of the gauze and the tampon itself is absolutely painless, a factor to which I attach the highest importance.

In cases of a large neglected abscess it is my custom to rely largely upon this large tampon and not use any sutures in the abdominal wall. Sutures in the abdominal wall have two disadvantages: (1) Stitch holes are likely to become infected and be of themselves a complication, and (2) by locking up of the fascial planes, which are likely to become infected, secondary infection of the abdominal wall with necrosis of the fascia and sloughing may occur.

By the omission of sutures and reliance on the tampon, we have for the most part a wound which has absolutely no reaction and is absolutely painless. In fact, we have the impression that the convalescence of patients treated in this way is very much more comfortable than by other methods.

As the wound closes the abdominal walls can come together over the abdominal contents; that is, these, having been held back at the outset, will not intrude into the wound as a wedge. We are under the impression that these wounds do not give rise to so bad herniae as do wounds drained in the usual fashion.



FIG. 3.—Method of introduction of tampon.

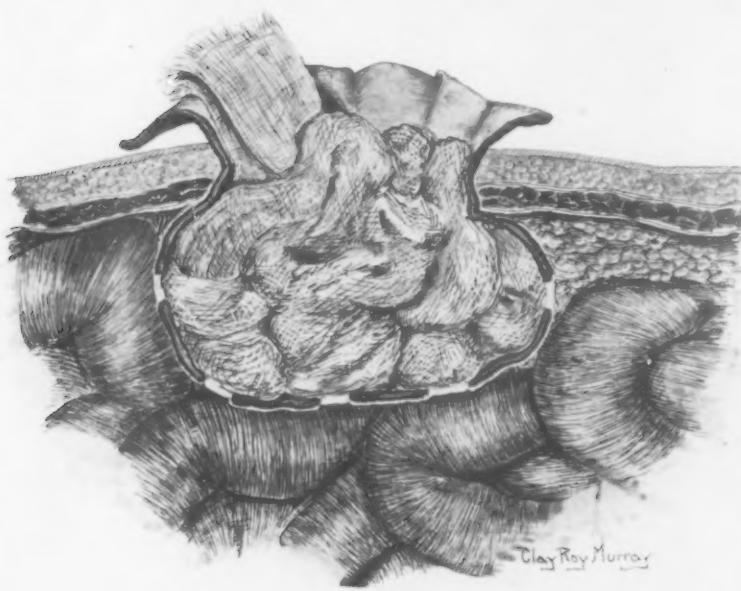


FIG. 4.—Rubber dam Mikulicz tampon.



FIG. 5.—Modified tampon in situ.

## THE GIBSON-MIKULICZ TAMпон IN ACUTE APPENDICITIS \*

BY CHARLES E. FARR, M.D.  
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THE subject of drainage in acute inflammatory processes is, and always has been, vigorously debated. In no field is this more true than in acute appendicitis. Men of great experience and skill in abdominal surgery differ to the widest extremes in this respect. Some never drain unless forced to, and then only with the smallest possible material through a counter-opening; others use rubber tubes, glass tubes, large cigarette drains, etc.; a few pack the wound wide open with gauze.

Aside from the question of weak scar, intraperitoneal adhesions, and slow healing, few would object to leaving these infected wounds wide open. This is the rational and accepted procedure in other parts of the body and would unquestionably be used here except for these three objections.

The peritoneum has such marked resisting power to infection that great liberties may be taken with it in certain cases, a fact which explains the excellent results of our more radical confrères. There is, however, a sharp limit in this direction, and all of us now agree, I believe, that certain types of appendicitis require drainage. The question of which cases to drain and the means to employ are still subject to debate.

On the Cornell Division of the New York Hospital, in the service of Dr. Charles L. Gibson, it has been the custom not to drain when the stump of the appendix could be inverted or securely ligated and when there was little or no extension of the inflammation beyond the appendix proper. A moderate amount of turbid serum is not a positive indication for drainage. However, any odor to the exudate makes drainage imperative, in our opinion. Oozing, not readily controlled, even in a case otherwise acceptable for closure, also demands drainage.

As a general rule we drain when in doubt and, in the doubtful cases, use only a small cigarette or folded rubber dam, inserted to the base of the appendix. This is almost invariably done through the laparotomy wound, as we rarely, if ever, use a stab wound drain. Such drains are extracted in twenty-four or forty-eight hours, and primary healing is the usual result. Occasionally, however, through misjudging the case and the amount of drainage needed, a fairly severe infection ensues. This is also true at times in cases sewed up tight. The infecting power of the appendix has been made a subject of careful study during the past two years and will be reported in a subsequent paper.

In the more severe types of appendicitis, with widespread peritonitis, or

\* Read before the Surgical Section of the New York Academy of Medicine, February 4, 1921.

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large foul abscesses, especially the retrocaecal and pelvic types, we have employed, following the custom introduced by Doctor Gibson, the modified Mikulicz tampon. At times a few sutures are introduced in the parietes, but in general none are used. A firm pack of plain gauze inside the rubber dam is sufficient to wall back the intestine and a careful adhesive strapping prevents the expulsion of the whole mass with the bowel.

A review of all the cases of acute appendicitis occurring in the ward service of the Cornell Division during the years August 1, 1914, to August, 1920, has been made, numbering 818. Of these a large proportion, presumably 50 per cent., were closed without drainage. A smaller number were closed partially, using cigarette or folded rubber dam or rubber tube drain, and 162, or 19.8 per cent., were dressed with the Mikulicz tampon.

The mortality in the entire series was 34, or 4.15 per cent. In the Mikulicz cases it was 20, or 12.3 per cent.

It would of course be unfair to compare the Mikulicz series with the other acute cases as only the very severe types received the former treatment. A comparison of a Mikulicz series with another similar group of extreme cases treated by the usual forms of drainage, by the same operators, would be of some value, but unfortunately is unavailable. Comparison with other operators is of little worth because of variations in individual skill and judgment, especially in the classification of cases.

The post-operative course of the Mikulicz cases is of considerable interest. In the great majority there is an almost immediate cessation of the acute abdominal and systemic symptoms and convalescence is remarkably smooth. Dressings are practically painless. The parietes never undergo phlegmonous infiltration. Sloughing of the aponeurosis is rare. The wounds clean up superficially very quickly and cease discharging about the fourteenth day. Healing to a superficial granulating area occurs from the twenty-first to the thirty-fifth day, when the patients are allowed to leave the hospital. Complete healing occurs, as in all intraabdominal cases, at varying periods, depending on intraperitoneal conditions largely. Stitch sinuses are of course not seen.

It is well known that drainage of the general peritoneal cavity cannot be maintained more than forty-eight hours, but one has only to see the enormous amounts of secretion on the Mikulicz dressings for the first seventy-two hours to realize that something, presumably an injurious agent, is being eliminated. Taken in conjunction with the clinical manifestations, we feel that beyond reasonable doubt, our patients are relieved of their toxæmia by this thorough elimination. We feel that this factor occasionally turns the scale in critical cases.

Pocketing or residual abscess is rare under this treatment. When it does occur, relief is usually easy without an anæsthetic. A gloved finger in the wound quickly finds the encysted collection and induces free drainage.

By the fourth day the pack is usually entirely removed, the rubber dam or a fresh one, inserted, and measures conducive to cleansing the wound are

## THE GIBSON-MIKULICZ TAMпон IN APPENDICITIS

instituted. The Carrel-Dakin treatment has given good results at this stage.

Evisceration has occurred very rarely and almost, if not entirely, in moribund cases. These seem to have little or no power to form adhesions and evisceration occurs as it does even in sutured wounds.

No attempts have been made at secondary suture in these cases. They have been strapped when clean, allowed to heal, and kept under observation for a year. At first the scars are linear and not easily told from sutured wounds, but gradually they hypertrophy and broaden out. A certain number develop hernia, usually a small affair and easily remedied. A few have been more extensive but in none has the repair been difficult, since no aponeurosis is lost.

An interesting feature of the repair has been the study of intraperitoneal conditions. We have been greatly impressed with the absence of adhesions of any moment and attribute this to the prompt alleviation of the local peritoneal suppuration.

### CONCLUSIONS

We have no comparative statistics to offer that would be of any value, but we are quite sure from careful observation over a period of years and a considerable series of cases, that the Gibson tampon does lessen mortality in the very severe type of cases. We feel also that it lessens morbidity and suffering and that the number of post-operative hernias is no greater than in other forms of treatment, that the hospital stay is no longer, that the conditions of the wound and the intraperitoneal conditions are better than by any other form of drainage. If these things are true, the tampon, as improved by Doctor Gibson, is a real step in advance in the treatment of the more severe types of appendicitis.

I am greatly indebted to Doctor Gibson for the privilege of reporting these cases, all of which were operated upon in his service by the various members of the staff. I would also gratefully acknowledge the help received from Dr. John Lyttle for his help in compiling these statistics.

### ACUTE APPENDICITIS—GIBSON-MIKULICZ TAMПON—ONE HUNDRED AND SIXTY-TWO CASES

Deaths, 20—12.3 per cent.

Excluding deaths, 142 cases; average stay in hospital, 22.4 days.

Shortest stay in hospital, 8 days.

Longest stay in hospital, 63 days.

#### *Incision:*

Intermusc., 74, or 52.1 per cent., average stay in hospital, 19.3 days.

Split rectus, 42, or 29.8 per cent., average stay in hospital, 25.5 days.

Rectus retracted, 26, or 18.1 per cent., average stay in hospital, 23.5 days.

Three reoperations for miscellaneous conditions, abscess, sinus and T.B. peritonitis.

Evisceration, 1; died on third day.

Repair—all successful.

CHARLES E. FARR

MIKULICZ CASES

Total cases, 162.

Deaths, 20, or 12.3 per cent.

No follow-up record, 22, which leaves 120 cases to be considered.

Hernias occurred in 21 cases, or 17.5 per cent.

Reoperation in 12 cases, or 57.1 per cent.

*Incisions:*

Intermusc., 62, or 51.6 per cent., gave 13 hernias—20.9 per cent.

Split rectus, 34, or 28.3 per cent., gave 7 hernias—20.5 per cent.

Rectus retracted, 24, or 20.1 per cent., gave 1 hernia—4.1 per cent.

*Incisions in 21 hernia cases:*

Intermusc., 13, or 61.9 per cent.

Split rectus, 7, or 33.3 per cent.

Rectus retracted, 1, or 4.9 per cent.

## CONGENITAL VALVES OF THE POSTERIOR URETHRA

BY ALEXANDER RANDALL, M.D.  
OF PHILADELPHIA, PA.

OBSTRUCTION to urination from congenital valve formation in the posterior urethra though mentioned by Langenbeck in 1802, and subsequently by Velpeau (1832), Jarjavay (1865), and Tolmatschew (1870), is of sufficient rarity that Young, Frontz, and Baldwin (1919), collected but twenty-four case reports from the literature, though enriching it themselves by twelve further cases.

In that but *three* of these thirty-six cases were diagnosed by clinical means before operation, I felt the following report of two cases worthy of presentation.

The theories presented to account for such valve formations are of interest. (Quoting from Young, Frontz and Baldwin.) Up to the time of Bazy's article in 1903, they were assumed to be simple overgrowths of the small anatomical ridges that normally extend from the verumontanum upward to the vesical neck and from the same downward to the urethra walls. Bazy contended that the urogenital membrane of the embryo would occupy in the later stages of development, a position corresponding to the most frequent site of the valves in question, and believed these valves a persistence of this membrane. Thompson (1907) accepted this view and amplified it by likening the valves to an imperforate hymen, or persistent anal membrane. Lowsley (1914) considered them an anomaly of the Wolffian and Mullerian ducts. Young (1919), analyzing the thirty-six cases he reports, finds three different types of valve formation and assigns to the different theories their respective types, while at the same time calling attention to the work of Watson on the embryology of the verumontanum, who illustrates in a fourteen-weeks-old foetus abnormal bands attaching the top of the verumontanum to the roof of the urethra as another possible origin.

The vast majority of these cases are brought under observation during infancy or early childhood: thus twelve are reported under one year; nine from one to five years; four from five to ten years; making a total of twenty-five under ten years, as against nine above that age. The youngest is reported by Fuchs in a five-months foetus, while the oldest, a man of eighty-five years, was reported by Iverson.

CASE I.—J. C., aged five years, entered University of Pennsylvania Hospital May 23, 1917, in the service of Dr. Crozier Griffith, with the complaint of dysuria. It had been noted by his mother six months before that when he urinated he would cry. At one time

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\* Read before the Philadelphia Academy of Surgery, December 6, 1920.

ALEXANDER RANDALL

it was observed that he passed a small blood-clot. He continued to suffer pain at each urination, and his mother observed that it would cut off two or three times during the act. His condition became progressively worse, and for the two days before admission he had been drowsy and refused to talk. Passed urine with difficulty the day before admission, and catheterization was imperative when the child was first seen in the receiving ward. Has had no diseases of childhood, though for two months before urinary difficulty was noticed, an excessive mucus discharge was observed at the meatus. The family physician states that at the onset of the trouble (October, 1916) the urine showed albumin, pus and blood-cells, but no casts. Temperature on admission was  $100.2^{\circ}$ .

*Physical Examination.*—Child lies quietly except for occasional choreiform movements of different parts of body, trunk, arms, legs or head. Is apparently stuporous, and dozes off when undisturbed. Examination of head, eyes, mouth and chest, negative. Abdomen very slightly distended, not tender except between symphysis and umbilicus. No muscular rigidity, no masses, no tenderness in costovertebral angles; genitalia and extremities normal.

Voided two ounces at 5 P.M. on day of admission, and three hours later bladder was found to extend half way to umbilicus, and the catheter recovered 8 ounces of urine with white,ropy sediment. Catheterization was not easy, though the difficulty was attributed to "muscle spasm." Child refused all nourishment and feeding was performed through nasal tube.

During the next three days the bladder was drained by inlying catheter and lavaged daily; improvement in urinary output and mental torpidity was marked. X-ray of urinary tract on May 27th was negative. On May 31st patient was urinating painlessly, and the elevated temperature had reached normal. The following day complete retention again occurred, the temperature rose to  $103^{\circ}$ , and the catheter was replaced with immediate relief of all symptoms. This sequence of events was repeated on two further occasions during the subsequent three weeks, and on June 21st cystoscopy was performed with the following report: "Bladder cavity very large; mucous membrane shows mild cystitis; both ureteral orifices are large and relaxed and a heavy cloud of pus seen to come from the right orifice. In the region of the verumontanum is a large, round, pale-white body, which almost occludes the posterior urethra and rises from the floor of the canal."

At the time this was considered a cyst of the prostatic utricle. On June 26th the patient was etherized. The supposed cyst was punctured with the fulgurating wire, and when it was seen not to collapse, the electric current was turned on and the entire mass of obstructing tissue severely desiccated.

Following this, the patient urinated voluntarily and without pain, and improved rapidly. On July 7th a third cystoscopy showed the obstruction to be absent, and only a small slough still adherent at

## CONGENITAL VALVES OF THE POSTERIOR URETHRA

the site of fulguration. Both ureters were catheterized and their respective renal pelvis lavaged with  $\frac{1}{2}$  per cent. silver nitrate solution; pussy urine was obtained from the right which on culture showed *B. pyocyanus*. On July 22nd the child was found to have five ounces of residual urine and a practically zero phthalein test, a slight discoloration only being obtained at the end of forty-five minutes' observation. Clinically he was greatly improved and sent home on August 5, 1917, under the care of his mother, a most intelligent woman. Report from the family physician on December 1, 1920, three and a half years later, states that the child has continued perfectly well, has developed normally, and has had no urinary difficulty at all.

*Comment.*—The condition in this patient was not appreciated until study of the literature brought forth the real embryological and pathological significance. It was evidently the third type of obstruction described by Young where an annular diaphragm obstructs the urethra, which diaphragm may be wholly or incompletely developed. On cystoscopy it appeared under the pressure of the irrigation as a tense wall suggestive of a cyst, but its failure to collapse when punctured immediately proved its character.

**CASE II.**—A. M., aged sixteen years. Admitted to University of Pennsylvania Hospital September 25, 1920; Cuban by birth; referred by Doctor Wilbur, of Hightstown, N. J., with a complaint of urinary frequency and enuresis. The patient had scarlatina at nine years of age, and no other disease nor any operations. During the past two years he has developed a frequency of urination which at first was every two hours and lately every hour. Even at his best urination becomes imperative at three hours and associated with pain just above symphysis. For the past ten months nocturnal enuresis has been constantly present. Once, about three months before observation, he had passed slightly bloody urine over a period of two weeks. His family and other personal history is negative, and he does not remember any urinary difficulty or weakness during childhood. Father, mother and one brother living and well. No brothers or sisters dead.

*Cystoscopy* (September 28th).—Instrument passes with ease and finds a small (10 c.c.) residual urine. The bladder wall is of normal pallor with slight trigonitis. The right ureter appears normally placed, but seen to gape open excessively on functioning. As the supposed left ureteral orifice was being located, the patient had a vesical spasm and the cystoscope was pushed into the posterior urethra. Further vesical cystoscopy was of little avail. The posterior vesical lip is a thickened bar with tense striations extending from it to the verumontanum, the latter being drawn up in close proximity to the vesical orifice. Instillation of  $\frac{1}{2}$  ounce of 1 per cent. mercurochrome.

ALEXANDER RANDALL

September 30th.—Catheterized specimen of bladder urine gave sterile culture.

October 4th.—Phenolsulphonephthalein test: 25 per cent. for first hour; 5 per cent. for second hour; total, 30 per cent.

*Cystoscopy* (October 6th).—Intravenous administration of 1.5 c.c. of 0.4 per cent. indigocarmine. Dye seen to be secreted in very faint traces in irrigation water in fifteen minutes and not observed from either ureteral orifice as repeatedly vesical spasm expelled the instrument into posterior urethra. The prostatic urethra is markedly dilated. The vesical neck raised and bladder orifice relaxed. Deep pittings penetrate down into either lateral wall of the prostatic urethra and at the extremity of the verumontanum is seen a fine frenulum which extends distally for about 1 cm. and, in dividing, forms what is apparently a definite valve on either side of the urethra, rising from the floor to each side wall.

Condition considered congenital valves of the posterior urethra, with pressure dilatation of the same and low kidney function from back pressure. For the next few days the patient showed an elevated temperature, and slightly elevated leucocyte count. There was slight cough and tenderness over Poupart's ligament. A second urine examination was negative for tubercle bacilli, as likewise a sputum examination. Wassermann and stool examination also negative. Blood studies practically normal.

October 20th.—Catheter placed in the bladder and 75 c.c. of 25 per cent. sodium bromide solution allowed to flow in under fluoroscopic examination. The opaque material was seen to immediately ascend to the right kidney pelvis and at the moment of vesical spasm a plate was exposed, which shows a small, markedly contracted bladder, distended posterior urethra limited at the valves' site, a dilated right ureter and right renal pelvis.

Close study of X-ray plates fails to show any evidence of a shadow from a left kidney. Two subsequent efforts to catheterize a left ureter were failures, principally on account of the vesical spasm on slight dilatation, making instrumentation very difficult.

*Cystoscopy* (October 29, 1920).—Both valves severely fulgurated and destroyed.

October 30, 1920.—Patient remarks voluntarily that urination is easier than he ever remembers.

*Comment.*—This is the first case that has ever been observed where the ureteral and pelvic dilatation has been unilateral. It is commonly recognized that one abnormality of the urinary tract is oftentimes accompanied by other congenital defects; though I tried every means within reason to establish the presence of a left kidney, the same remains clouded in doubt and for the present contraindicates surgical intervention other than the above effort to destroy the obstruction in the posterior urethra.

## KRUKENBERG TUMOR OF THE OVARY\*

BY PHILIP J. REEL, M.D.  
OF COLUMBUS, O.

INTERESTING problems of investigation are always encountered when an attempt is made to account for the exact origin of solid tumors of the ovary. No organ in the human body presents more difficulty in the histogenesis of its tumors. These growths comprise fibromas, sarcomas and carcinomas, and while not exceptionally rare, neither are they the types most frequently encountered. This group of neoplasms taken collectively possibly occur more frequently than the literature would seem to indicate. Fibromas and sarcomas are usually given as comprising 2 per cent. and 5 per cent. of all ovarian tumors, while carcinomas are of much more rare occurrence.

In 1896 Friedrich Krukenberg described a bilateral ovarian tumor to which he gave the name "fibrosarcoma ovarii mucocellulare (carcinosomatodes)." Although he considered these tumors of a fibrosarcomatous nature, his attention was directed to various areas wherein large epithelial cells appeared, some of which were arranged in definite tubules. These cells were described as being distended with mucoid material, which, after pushing the nucleus to one side, caused them to present a signet-ring appearance.

In 1917 our attention was drawn to the Krukenberg tumor of the ovary while making a study of ovarian neoplasms. At this time a bilateral growth of the ovary was encountered in a woman of thirty-three years. Operation disclosed a retroperitoneal involvement of the lymphatics but failed to reveal any definite evidence of a primary growth in the gastrointestinal tract. In 1916 Stone called attention to the importance of cancer metastasis, emphasizing the possible channels by which secondary growths make their appearance in the ovary. He concluded that metastasis occurs either by direct extension through the retroperitoneal lymph-nodes, by permeation or retrograde transportation, or by peritoneal implantation. Major in 1918 presented an excellent paper including a review of the literature and cases reported to date and was of the opinion that surface infection may play an important rôle in explaining the route of certain metastases. In the case studied by him, however, the blood-stream was suggested as a possible route, by finding the tumor cells in the pulmonary circulation at the time of autopsy.

Krukenberg in his original study considered the tumor as being primary in the ovary. Since then it has ever been the occasion of considerable discussion. A review of the literature reveals one group of observers

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who describe the tumor as being primary, while the other group consider it as a secondary growth. It would seem that a misinterpretation resulting from insufficient data could account for quite a number of the cases considered primary in the ovary. It is generally recognized that a malignancy occurring as a bilateral involvement in paired organs, such as the kidneys and ovaries, in most instances indicates a primary growth situated elsewhere in the body, which may present no clinical symptoms, and may be impossible of clinical diagnosis.

In order to avoid repetition, a brief résumé of Major's conclusions with reference to the cases collected up to 1918 would reveal that fifty-five cases have been reported in the literature, and to these eight probable cases may be added. "Eighteen cases were collected in which the



FIG. 1.—Gross photo of ovaries. The darkened area of the larger is that of recent hemorrhage.

presence of a primary growth in the gastrointestinal tract was demonstrated." To these we may now add a case reported by Chapman in July, 1920, and the one serving as a basis for this discussion, making a total of twenty.

The following case is presented as a contribution to the study of this most interesting subject. The striking feature of this case is the lack of symptoms presented until just a few days prior to operation in spite of the presence of a marked pelvic and abdominal involvement.

The patient, H. H., a white girl, single, aged twenty-one years, was admitted to the University Clinic complaining of acute abdominal pain associated with what she stated was a rather sudden enlargement of the abdomen. Her family and past history were negative. She began menstruating at eleven years and had always been regular, flowing from four to five days, with no pain or discomfort until the period in which this attack commenced. The patient while bending over to lift a pail of milk was taken with a sudden, sharp pain in the lower abdomen. This pain was so excruciating

## KRUKENBERG TUMOR OF THE OVARY

that momentarily it was impossible for her to arise. During the next few hours the menstrual flow increased very greatly in amount. She was insistent that it was at this time that she first noticed the abdominal enlargement. A little later, however, a more careful questioning revealed the fact that she had worried some over a possible pregnancy during the past three or four months, because of a progressive enlargement of the lower abdomen, even though she had not experienced any of the more common symptoms. There had been no gastrointestinal disturbances or loss of weight prior to this attack. Her family physician was called and diagnosed the condition as an "acute surgical abdomen," and sent her into the Clinic on the following day, July 6, 1920.

When seen in the hospital under the service of Doctor Wardlow and myself she complained of abdominal pain, low down, and presented some tenderness over the left and larger of the two palpable masses. Her temperature was  $102.5^{\circ}$ . This fell to normal after a few hours rest in bed and remained so.

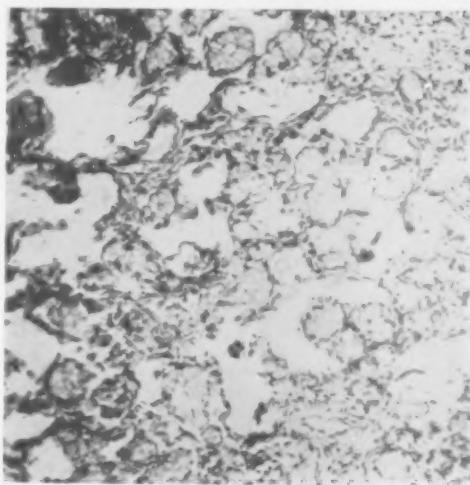


FIG. 2.—Photomicro, low power, showing stroma arranged loosely and enmeshing the tubule-like arrangement of the epithelial cells.

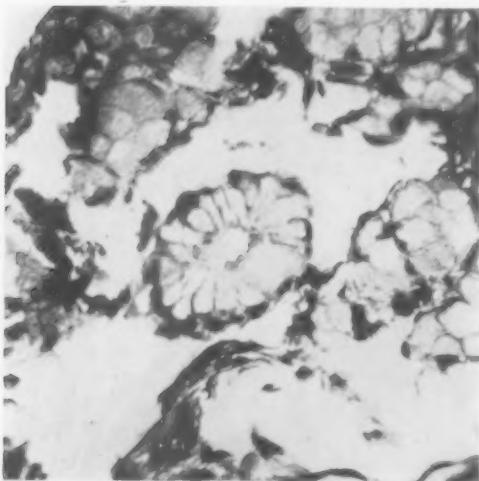


FIG. 3.—Photomicro, higher power, showing cross-section of tubule. This has every appearance of being gastrointestinal in origin.

Physical examination of the head, neck, and chest revealed nothing of note. The lower abdomen was irregularly distended. Palpation disclosed two distinct tumor masses apparently arising in the pelvis. These enlargements while cystic in shape were non-fluctuant and presented strong evidence of being solid. The growth on the left side extended well out of the brim of the pelvis and ended bluntly but distinctly about two fingers' breadth below the umbilicus. There was some



FIG. 4.—Photomicro, high power, showing a more cellular area composed of large ovoid-shaped cells distended with mucoid material which has pushed the nucleus in many instances to one side, forming a signet-ring appearance.

men was opened and revealed an enormous enlargement of the left ovary with a similar but smaller involvement of the right. About 500 c.c. of clear serous fluid was found free in the cavity. The size of the left ovary necessitated an incision well above the umbilicus, rendering possible very thorough examination of the entire abdomen. The stomach was found to be markedly involved and undoubtedly presented the primary growth. From this the omentum, mesenteries, anterior surface of the spleen and a large portion of the small and large intestine were invaded by metastatic extension. The liver and gall-bladder were entirely free. The parietal peritoneum of the pelvis was studded with nodules. These increased in size and number as the more dependent portions of the pelvis were reached. The uterus was smooth and no larger than one which has been pregnant and had undergone normal involution. The extensive involvement of the broad ligaments and surrounding structures prevented its removal. A double salpingo-oophorectomy was performed.

The immediate post-operative convalescence was uneventful, and the patient left the hospital on

tenderness over the anterior portion of this mass. The growth on the right could be palpated just above the pubes. Both were slightly movable from side to side. Pelvic examination revealed a small, hard, conical cervix and a palpable fundus immediately behind the symphysis. Under ether relaxation both tumors were easily diagnosed as being ovarian. The urine, blood, and Wassermann were negative.

On July 7, 1920, under ether anaesthesia, the abdo-

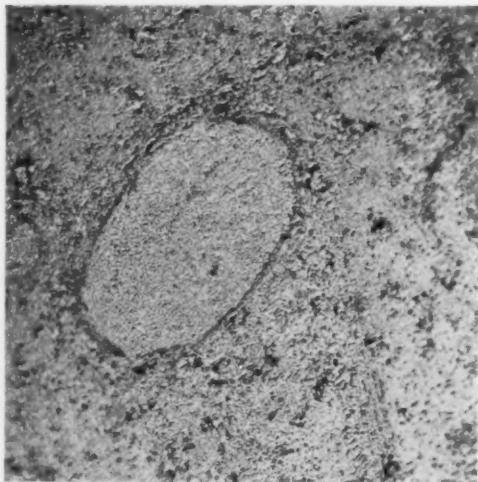


FIG. 5.—Photomicro, low power, showing area of hemorrhage. The blood-vessel is engorged with blood, surrounding which is a marked perivascular hemorrhage.

## KRUKENBERG TUMOR OF THE OVARY

August 15, 1920. Shortly after, however, she began to lose weight and died September 10, 1920. Unfortunately it was impossible to obtain an autopsy.

Grossly, both ovaries and tubes retained their normal shape and contour. The left weighed 1110 gms. Its general smoothness was interrupted by what seemed to be merely enlargements of the indentations and cleft-like scars seen on the surface of the normal ovary. The general consistency was firm throughout, with an occasional small area of superficial softening. The anterior, and a portion of the external lateral surface, presented a rather large area of hemorrhage of recent date. This no doubt explains the attack of sudden pain. The accompanying tube was moderately enlarged and congested, but presented nothing further. Upon section, the cut surface was whitish in appearance, excepting for the area of hemorrhage, and the entire tumor was solid, presenting several areas of myxomatous degeneration, and one small cyst measuring 2 cm. in diameter. The right ovary and tube, although smaller, weighing 360 gms., presented the same general structure minus the hemorrhage and cyst formation.

Microscopic examination revealed no normal ovarian tissue in the many sections studied. The stroma, in its arrangement, corresponds in every way with that accepted as the Krukenberg tumor. Distributed throughout the connective tissue are cells which, in their morphology and arrangement, have the distinctive appearance of epithelium. Although infiltrated with these cells, connective tissue predominates in certain areas, while in others it is loose, and enmeshes the tubule-like formations. Again, in other portions, the cellularity is marked and these large clear cells distended with mucoid material constitute the entire picture. In the less compact areas the stroma takes on a myxomatous appearance. Many of these tumor cells, ovoid in shape, are greatly enlarged and filled with a clear mucoid material which in many instances has pushed the nucleus to one side, causing a signet-ring appearance. Throughout the tumor, these cells show a decided tendency to arrange themselves in tubules.

When an attempt is made to interpret the findings at the time of operation, it would seem highly improbable to consider the ovarian tumor to be anything but secondary to a primary growth elsewhere in the abdomen. This was undoubtedly in the stomach from which the metastatic growth had taken place. This impressed one as being in the nature of rays of light extending downward along the contiguous surfaces of the underlying viscera, and ending in a focus in the pelvis. Although not proved by autopsy, it would seem that peritoneal implantation or surface infection as described by Major played an important part in the route of extension. The freedom of the liver from metastasis would hardly have been likely in the presence of such marked involvement elsewhere, had the lymphatic system been the channel of secondary invasion.

PHILIP J. REEL

SUMMARY

The histogenesis of solid tumors of the ovary is always interesting and should warrant a careful investigation of each case encountered. This tumor is similar to that described by Krukenberg, but presents very strong evidence of being metastatic in origin. This bears out the more recent investigations which tend to prove that, in the vast majority of instances, solid tumors of the ovary are secondary to a primary tumor situated elsewhere in the body.

It is possible for these growths to attain enormous proportions in the absence of clinical manifestations. A review of the literature reveals that they occur most frequently before the age of forty, and that they are more malignant in character than is sometimes stated.

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## THE TREATMENT OF UNUNITED FRACTURES\*

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UNUNITED fractures may be classified in two groups, fractures delayed in uniting and fractures that may properly be regarded as without union. The chief difference between the two types is that often the former may be coaxed, as it were, into solidity by some means other than operative procedures, whereas the latter is a fixed condition that will not change and union can be obtained only by operative means.

Any measure that will bring about union in such cases may be employed, but most surgeons doing a great deal of bone work find that bone grafting is the preferred method. The intramedullary graft advocated by Murphy has been employed successfully in certain cases, and may still be included in the different procedures of obtaining union, but it has been my experience that it does not compare favorably with other methods. The objection to the intramedullary graft is that it is a piece of cortical bone placed within the medullary cavity, in reality a foreign body, which is gradually absorbed. It only aids in obtaining union because it acts as a splint primarily, as a mild irritant secondarily, which leads to increased blood supply to the fractured ends, and because it has within itself the natural bone salts necessary to insure the deposition of callus.

The sliding inlay graft advised by Buchanon and Albee appears to be well-nigh perfect mechanically. The inlay as a sliding reversible graft in the tibia is probably the method of choice in the repair of this bone if a high degree of osteoporosis is not present. Because osteoporosis is often present it has failed in the hands of skilful operators, and it is now usual to take the bone from the opposite tibia and practically never to use a sliding graft in other bones.

It is difficult to determine just why the inlay graft should fail in cases in which we have known our technic was all that could be asked. Recent investigations in bone transplantation and bone regeneration have brought out the fact that cancellous bone of the endosteal tissue is rich in osteoblasts. These cells make new bone; the adult bone-cells probably have little or no bone-forming properties. The osteoblasts are to be found in small numbers beneath the cambium layer of the periosteum, in slightly greater numbers in the Haversian canals, and in the greatest numbers in the cancellous bone. It is therefore essential that

\* Read before the State Meeting of the American College of Surgeons, Denver, Colorado, December, 1920.

as much as possible of the cancellous tissue of the fragments and of the cancellous tissue of the grafts should be saved and placed in contact.

When the slot is made for the inlay graft, the cancellous bone and all layers of bone are removed the entire length of the slot, and after the

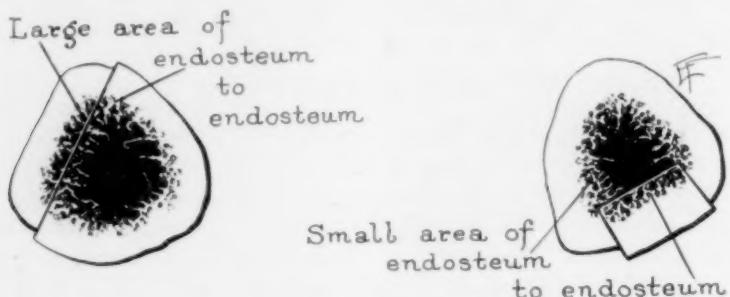


FIG. 1.—Areas of endosteum to endosteum.

bone graft is fitted into the slot, the only point of contact between the cancellous tissue of the graft and the cancellous tissue of the fragments is at the edges of the graft (Fig. 1); thus comparatively little cancellous tissue meets cancellous tissue, and since this is the tissue that furnishes the largest number of osteoblasts or bone-forming cells, it is not to be wondered at that the graft's vitality is often lost and that the graft is slowly absorbed.

I believe it is more than probable that a bone graft may retain its vitality if enough contact of cancellous tissue of the graft to the cancellous tissue of the fragments is secured. Therefore, it is now my custom to use the bone graft in the form of a massive graft in which the periosteum and hard cortical bone of the fragments are chiseled off, exposing a large area of cancellous tissue. Against this is placed the cancellous or endosteal side of the graft which contains all the layers of bone; this is clamped or held in place by the aid of beef-bone screws (Fig. 1).



FIG. 2.—Non-union of the tibia and fibula in the lower third.

teum and hard cortical bone of the fragments are chiseled off, exposing a large area of cancellous tissue. Against this is placed the cancellous or endosteal side of the graft which contains all the layers of bone; this is clamped or held in place by the aid of beef-bone screws (Fig. 1).

## THE TREATMENT OF UNUNITED FRACTURES

In a recent study of the end-results following forty-two operations for non-union of the humerus on thirty-four patients, it was found that the use of the massive graft gave a higher percentage of good results than any other method. Next in importance to the proper method of using the bone graft is the problem of post-operative fixation. The fixation must be varied according to the case and the conditions surrounding the patient and the surgeon, but plaster-of-Paris is probably the most convenient method of securing the necessary fixation. For fractures of the



FIG. 3.—Union by the inlay graft obtained from the opposite tibia. Beef-bone screws were used to hold the graft in place.



FIG. 4.—Non-union of the tibia and the fibula of seven years' duration.

humerus a ledge or trough for the arm to hold the elbow flexed and across the front of the body is incorporated in a body cast. Immediately after the operation the arm is placed in this trough, covered by plaster-of-Paris bandages, and securely bound to the side for from four to eight weeks. If the patient's temperature is normal and there are no signs of infection it is not essential to examine the wound for eight or ten weeks even though non-absorbable dermal sutures are used. In the fixation of fractures of the tibia, naturally the ankle and the knee must be included in the cast. In the fractures of the thigh the cast may include

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the pelvis and extend to the toes. In certain high fractures of the femur, or in fractures of the hip, it has been our custom to apply a plaster-of-Paris double spica cast extending from the ribs to the toes on the affected side and to the knee on the opposite side, with the legs in abduction, the cast being reinforced by a splint placed transversely from knee to knee. In the forearm the cast should run to the heads of the metacarpal bones and up to the middle of the arm at least.

Many of these ununited fractures have been operated on before we see them. Many have been compound fractures with infection. Unfor-



FIG. 5.—Union obtained by taking the fibula from the same leg and using as a massive graft. Beef-bone screws were used to hold the graft in place.

tunately, even after the extensive experience furnished by the war, there is no hard and fast rule as to the exact time operation is safe in cases previously suspected. We have seen cases in which the infection was stirred up eighteen months after the sinuses had closed, and cases in which there was a pocket of pus in the tissues a year after all sinuses had closed. As a rule, much may be learned from whether the wound is red, tender, edematous, and so forth, conditions which, in the main, are contraindications to interference. Successful interference has been reported in the face of such conditions, but such instances are the exception and not the rule. Certain types of

## THE TREATMENT OF UNUNITED FRACTURES

united fractures are often treated better by the aid of some metal plate, notably, fractures of the femur with marked deformity and considerable tension of the muscles when the fracture is reduced and the parts stretched. It is plainly evident under such conditions that something in the way of a firm internal splint must be used, and we have not infrequently found it necessary to use two metal plates to maintain the position. It is advisable, however, to tell the patient that these splints are put in merely as a temporary means of holding the fragments in position and that they should be removed when union has taken place. In recent years we have used metal plates less often, although we believe they should be recognized definitely as a proper means of treatment. It may be accepted as a good general rule that metal or non-absorbable material should be used as little as possible in the treatment of ununited fractures. Even in the femur we have used, of late, more beef-bone plates than metal plates. The bone is almost as strong and in fact stands more stress without bending than the metal. Beef-bone may break but will not bend, whereas the metal plates will bend and allow malalignment.



FIG. 6.—Non-union of the neck of the femur of five months' duration.



FIG. 7.—Fibula used as a peg. Union secured.

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The metal plates are more applicable to recent fractures than to old ununited fractures.

As a rule, marked osteoporosity of fragments means failure. The osteoporosity may be due to prolonged fixation in apparatus or casts, and in such cases it is better to remove all fixation and encourage the use of the part. This may make the pseudoarthrosis more marked, but as



FIG. 8.—Ununited fracture of the ulna.

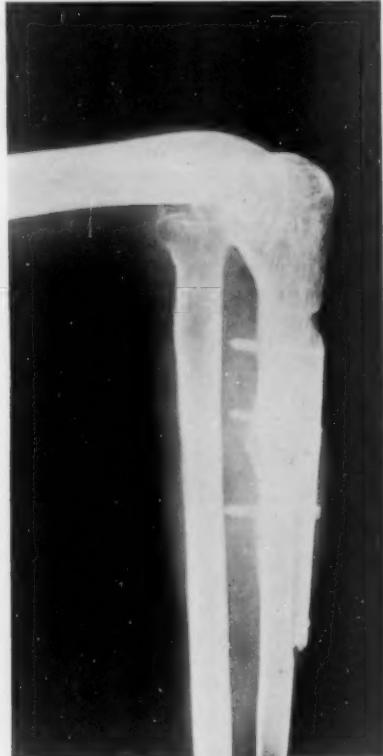


FIG. 9.—Massive graft taken from the tibia and applied to fragments, and held in place with beef-bone screws.

the bone ends become eburnated the necessary bone salts are deposited for bone repair.

Beef-bone screws may be used to hold the fragments in apposition, if the fracture is oblique, or if the step operation is performed. Holes are bored with a drill and then threaded by the proper size tap and beef-bone screws placed through. These screws are non-irritating and absorbable.

FRACTURES OF THE TIBIA

CASE 278532.—Mr. L. M., aged twenty-four years, came for examination July 5, 1919, because of ununited fracture of the right tibia and fibula, caused by a bullet from a revolver (Fig. 2). The bones had been sutured the next day with silver wire. Suppuration followed and five

## THE TREATMENT OF UNUNITED FRACTURES

months later the wires were extracted. The patient was operated on again within a year without union.

July 9, 1919, we placed a bone graft from the left tibia as an inlay, held in place by four beef-bone screws. Union followed (Fig. 3).

CASE 279058.—Miss M. J., aged twenty-one years, came for examination July 11, 1919, because of non-union of the lower third of the left tibia of seven years' duration (Fig. 4). She had been operated on five times, each time believing that union had occurred; twice metal plates and twice bone grafts were used, but each time the union broke down.

July 22, 1919, we operated, using a piece of the fibula as a massive graft. Good union was secured (Fig. 5).

### FRACTURE OF THE FEMUR

CASE 307814.—Mrs. M. M., aged thirty-five years, came for examination March 2, 1920. She had fallen on ice and fractured her hip about five months before. She was in bed ten days. Röntgenograms did not show a fracture at the time and she was allowed to be up on her feet for two weeks; a cast was then applied and worn for two and one-half months (Fig. 6).

At operation, March 12, 1920, the fracture at the neck of the left femur was found to be ununited. A piece of the fibula was used as a transplant. At examination June 25, 1920, union was complete (Fig. 7).

### FRACTURES OF Ulna AND RADIUS

CASE 321468.—Mr. S. W., aged twenty-one years, came for examination June 23, 1920. One year before his left forearm had been struck by an airplane propeller and the ulna fractured (Fig. 8). The fracture was set immediately and again two weeks later. Twenty-one days after the accident operation was performed and the bone plated. The bones did not unite and the plates were removed two months later and a cast applied for six weeks.

June 25, 1920, operation was performed at the clinic; a piece of bone from the flat internal surface of the left tibia was affixed as a massive graft to the fragments by the aid of four beef-bone screws. October 14, 1920, the bone graft was firmly united and the fracture solid.



FIG. 10.—Non-union of the humerus.

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FRACTURE OF THE HUMERUS

CASE 300181.—Mr. R. G. P., aged forty-five years, was examined at the clinic December 20, 1919. Nine months before the left arm was caught in the belt of an engine; the humerus was broken near the head and in the middle of the shaft (Fig. 10). The arm had been placed in a cast. Union was obtained in the upper fracture, but not in the lower.

We placed a massive graft from the tibia with three beef-bone screws in each fragment and union and full function were obtained in less than six months (Fig. 11).

RÉSUMÉ

As a result of our experience in the treatment of ununited fractures we believe that the bone graft is primarily the method of choice, but there



FIG. 11.—Massive graft, held in place with beef-bone screws.

are certain conditions in which it is probably not the best method. Frequently in operations on certain ununited fractures of the femur with much fibrous tissue and abundant callus, in which bleeding is very free and cannot be controlled absolutely, we have found it better to use metal or beef-bone plates, which are more easily applied than autogenous bone grafts. Beef-bone plates and screws are not irritating and have sufficient strength to stand the strain. In treating ununited fractures of the tibia the inlay graft is probably the method of choice; this, like all bone grafts, should be held firmly in place by the aid of beef-bone screws. In the femur and humerus, and in the radius and ulna, we prefer the massive bone graft which permits the approximation of the cancellous tissue, which is rich in osteoblasts, of the graft and of the fragments.

## AN INTEGRAL TRACTION-PROVIDING SPLINT FOR VICIOUS FRACTURES OF THE FEMUR \*

BY HARVEY C. MASLAND, M.D.

OF PHILADELPHIA, PA.

SINCE the Great War as a school of experience, much has been written concerning the care of fractures of the long bones. In fractures of the lower limb the Thomas splint has emerged supreme as the best emergency agent. Civil practice, however, is different from the conditions upon a battlefield. In a few hours the patient is removed to a place satisfactory for the permanent treatment of the injury. Hence the question is practically immediate of setting the fracture and providing the best mechanical means of holding the bones in normal relation till Nature has reunited the broken parts. In the selection of our equipment very many questions arise. There must be the most perfect possible correction of the deformity. The parts must be retained in this normal relation during the days of healing. The comfort of the patient must be given consideration. This is most important in those of lowered vitality or of advanced age. Many a life has been sacrificed, in fractures of the femur especially, for while the fracture has been retained in good position, yet the tax of the treatment has caused complications that have sapped the vitality.

Traction is an element that must be considered in every fracture of the long bones. Here must be considered the point that the misplaced bones act as an irritant to the surrounding soft tissues and excite a contraction that holds the bones in continued malposition. Logically, then, where the bones have been set in normal position not so great traction is necessary in the after care. A point that arises here is that a fracture which cannot be replaced by the indicated manipulations under ether will not give a greater degree of reduction under subsequent traction. Where there is marked deformity manipulation applied under ether will bring many of these bones into apposition and if the irregularity of the fracture is sufficient to catch and prevent slipping, the parts will remain in position till they are retained by gentle placement in an appropriate splint. To digress for a moment; in acute fractures, the question of open operation should only be considered where skilful manipulation fails to bring the parts to a sufficient replacement. If the parts can be brought into position but there is a non-serrated oblique fracture, then a suitable traction splint should prove sufficient.

With the presentation of these thoughts, we can now turn to the consideration of those fractures where our ingenuity is sorely tried in maintaining a replacement. I wish to consider, possibly the most rebellious of all, the vicious fractures of the femur.

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\* Read before the Philadelphia Academy of Surgery, December 6, 1920.

HARVEY C. MASLAND

The old dictum called for immobilization of the joint above and below the fracture. Numerous writers have maintained this was not a prime essential. The stiff joints that have followed the treatment of many fractures have been adduced as objection to the prolonged fixations of the joints. Undoubtedly there is a possibility of such a complication following, particularly in the aged, the rheumatic, or others of lowered vitality. The conviction is forced upon me, however, that many of these cases are caused by the irritation of the treatment and the incomplete replacement of the bones. It is nature attempting to minimize the injury to the tissues. In other words, the nearer we obtain a perfect replacement and a comfortable unirritating splinting, the less the likelihood of a permanent stiff joint. In my opinion, the fixation of the hip-joint and thus of the upper fragment for at least the first three weeks of the course of treatment of a fractured femur outweighs the danger of ankylosis.

All the various modifications of the Thomas and the Hodgen splints, the suspensions, the longitudinal and lateral tractions, the abductions of the limb, the Bucks and the ice-tong traction, have for their objects the giving of as much fixation as possible, as much traction as is needed and such position of the limb as would secure the greatest degree of muscle coöordination and relaxation. All these are planned to secure and maintain the best possible replacement. It is recognized that none of these treatments will permit the patient to ease the position of his body without moving the limb and disturbing the adjustments. This causes some pain with its consequent stress to the system. The tractions, longitudinal, vertical or lateral, are to some point on the bed. Any change of the patient's position disturbs the direction and the intensity of the pull of these tractors.

The two usual counterbalances to the limb traction are in the pelvic ring of the splint and the weight of the body. The pelvic rings are fixed sizes calculated to rest against the ischium, a one-point support. This permits of but a limited amount of pressure without pain.

These deficiencies work to the discomfort of the patient, the lack of accuracy in the treatment and the irritation of the soft and hard tissues. We must ever recognize that the degree of traction and pressure is limited by the ability of the patient to bear the strain.

My studies of this problem have extended over many months. I am convinced that the splints in use do not utilize all the opportunities offered by the body to distribute the strain and so allow greater traction with less discomfort. They distressingly limit the freedom of movement of the patient. I present this splint (Figs. 1, 2, 3) as an effort to solve the difficulties encountered. It is an advance over the splint presented in the April, 1920, issue of "ANNALS OF SURGERY." The present splint is indicated where a greater degree of traction is necessary as in fractures below the trochanters, where both lateral and longitudinal traction may be required. It is provided in such shape that the surgeon can readily bend and assemble to fit the individual patient. The splint has a body portion and a limb portion which can

FIG. 1

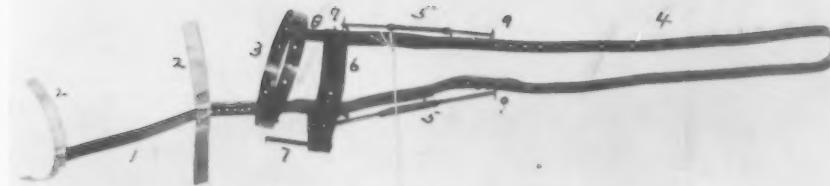


FIG. 2



FIG. 3

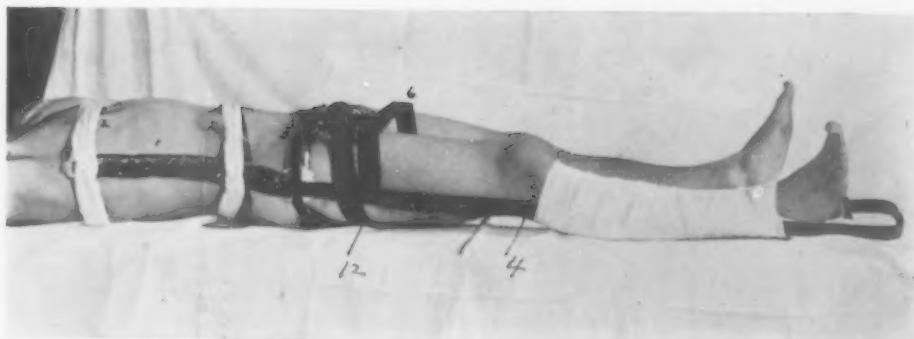


FIG. 1, 2 AND 3.—1, body splint; 2, axilla and waist bands; 3, buttock ring; 4, limb splint; 5, turn-buckles; 6, adjustable bridge; 7, bridge arm for lateral traction band; 8, upper inner thigh splint; 9, brackets for turn-buckles; 10, eyeletted artificial leather to lace over splint and padding; 11, guides to hold a-b and c-d during extension; 12, lateral traction band supported on arm 7.



## SPLINT FOR VICIOUS FRACTURES OF THE FEMUR

be immediately connected with screws and wing nuts. Where extension is needed this is not done before the turnbuckles have been mounted on the overlapping arms and the required extension made. It will be seen that if movement of the joint is required during the course of the treatment the two elements can be freed quickly at this point and the splint as a whole is not removed.

The body arm extends from the axilla, follows the lateral contour of the trunk past the pelvic ring and well down toward the knee. The pelvic ring is adjusted to rest as near as possible on the ischium, the pubic bone and the ilium. The trunk arm makes the hip-joint immobile. Following the curves of the body, it cannot turn as does a straight splint. Two cross arms at the axilla and the waist line are bound to the body with adhesive plaster. No bandages are used here and the back is open to bathing and other needful care. Attached to the pubic side of the pelvic ring is a splint arm which follows the inner contour of the thigh well down to the knee. The pelvic ring adjusted to the particular pelvic bone and the trunk arm likewise adjusted to the side of the body permit a distribution of the counter pressure so that a greater degree of strain with the turnbuckles can be exercised with less discomfort to the patient.

The leg portion of the splint has an arm extending down from the upper third of the thigh following the external contour of the limb. It is bent across the sole with abundant clearance for a Buck extension. It then turns up and follows the inner contour of the limb to within 4 or 5 inches of the perineum.

To measure the contour of the parts, the patient lies flat and straight on the bed. If he is symmetrical the sound side can be measured. A tape line is stretched from the axilla to beyond the foot parallel to the axis of the body. About every two inches from the axilla down, a ruler at right angles to the tape line gives the distance to the contacting part of the body. Special points like the axilla, the waist line, the ilium, the pubic crotch should be noted. Using a seam on the floor as a straight line these distances are marked and a connecting line gives the curves of the parts. The splints are then bent to these lines. At the ilium and the pubis the arms are sharply bent to accommodate the pelvic ring more readily. A pair of bicycle wrenches serve to make the curves, particularly the sharp bends for the pelvic ring. The length, circumference and height of the thigh at the pubo-ischiac iliac line are taken and the ring bent accordingly, allowing about four inches for padding, etc.

It will be noticed that all the arms have numerous holes. These allow the arms to be bent to any adult and yet permit a ready assembling of the various parts with machine screws and wing nuts. In the leg splints are additional holes which are threaded. The leg arms are to be imbedded in plaster of Paris to an extent to give a good brace for the extension with the turnbuckles. The threaded holes are for machine screws to be screwed in tight with the screw ends projecting away from the limb. These give an

anchor in the plaster of Paris. Before the plaster of Paris is applied a Buck extension is put on the leg. The plaster of Paris and Buck extension appeal to me as utilizing all possible vantage ground on the lower limb to distribute the strain. Where the thigh portions of the body splint and the leg splint are in relation to each other the arms of the body portion are placed external to the leg arms. This permits the more convenient assembling of the turn-buckle brackets and the bridge for lateral traction. It is perceived that when the turn-buckle brackets are fastened to the respective arms and the turn-buckles attached, opening the turnbuckle will exercise any degree of separation longitudinally that we can safely use. Some of the holes in the overlapping thigh splints are slotted. This insures that there will always be opposing openings through which to pass a screw. After distraction is complete and the added rigidity of the splint afforded by the turn buckles is not needed, the screws are passed through the overlapping ends and the splints are tightened on each other with the wing nuts. Then the turn-buckle assemblies can be removed, leaving a neater appearance.

For the lateral traction that may be needed two freely holed angle plates are attached opposite each other on the side splints with the other arms lapping over each other commensurate with the width of the thigh. These overriding arms are bound together with a screw and wing nut. An arm is now attached to this bridge at a point that will give the lateral traction in the direction desired. A broad band is passed around the end of bone to be elevated. The ends are brought over derrick arm and clamped tight with the degree of lift desired.

The body portion of the splint with the pelvic ring are padded and covered with artificial leather, laced on, before applying to the body. The other exposed parts are padded and covered with artificial leather after adjustments are completed.

To summarize the features of this fracture dressing:

The joints above and below the fracture are immobile.

The individual fit of the splints insures their better retention in position.

The body and the fractured part are open for inspection and the needful attention.

The strain of traction is distributed in wider degree over salient parts of the body.

The traction can be applied in the direction and to the degree required.

The traction is wholly integral to the splint.

The patient can move or be moved on the bed without disturbing the direction of traction or the relation of the parts.

Comfort and well-being are conserved in the highest degree.

## THREE FREQUENT CAUSES OF WEAK AND OF FLAT FEET\*

By J. TORRANCE RUGH, M.D.  
OF PHILADELPHIA, PA.

EXPERIENCE in the pre-combat work of the World War has justified to the writer the conclusion that the great confusion which existed among the medical officers (and still exists to a great extent among physicians) regarding foot disabilities arose from the classification of all weak or abducted feet as flat feet and the attempted division into three degrees. It was productive of tremendous harm among that class of soldiers who were seeking some excuse to escape service or were desirous of a transfer to a non-combat branch of service. It also caused great concern and anxiety to many good officers who worked hard to improve their status and who easily proved their efficiency along military lines, yet who feared for their future record because some uninformed or misinformed examiner had tagged them with a first or second degree flat foot, though the condition, whatever it might be, had never given rise to the slightest symptom in spite of intensive training and work. While in civil as well as in military experience, the most common causes of these mechanical defects were faulty shoes, weak muscles, overweight and faulty standing posture, there exists a fairly numerous class of cases in which there are found some mechanical defects of an anatomic character that have not received the consideration they deserve. These defects concern both the tendinous and the bony structures.

The first of these is a shortened tendo Achillis. Attention has been called to this by various writers, among the first of whom was Shaffer, and it has even been sometimes called "Shaffer's foot," but it has not apparently occasioned much concern among orthopaedic surgeons and is an unknown factor to the majority of others. Careful examination of the feet of 50,000 of the recently inducted soldiers showed that about 12 per cent. possessed heel tendons which would not permit of dorsiflexion of the foot to or beyond a right angle when the foot was held straight or slightly adducted and the knee was straight. Examination of the feet of a group of women from various walks of life, entering the nurses' training school of one of our largest Philadelphia hospitals during the past four years, has shown about 30 per cent. affected in this manner. This greatly increased number among women is undoubtedly due to the difference in the height of heel of the shoes of the two sexes, but still it is sufficiently common in each to demand a careful search for its presence and its prompt recognition. The mechanics of its ill effects are due to the downward and backward slope of the os calcis and the attachment of the tendon to the middle and lower portion of the posterior end. Also, in

\* Read before the Philadelphia Academy of Surgery, Dec. 6, 1920.

the normal foot, the os calcis points slightly outward from the centre of the ankle-joint, producing a normal tendency to slight abduction. The ill effects of this are counterbalanced by the solidity of the outer bony bulwark of the tarsals and metatarsals and the very short and low arch on the outer side of the foot. When, however, the tendo Achillis is shortened the forward tilting of the leg on the foot in walking throws a tension on this structure which produces one of two effects: either the heel is lifted from the ground as the body swings forward, or it remains on the ground and the foot is rotated outward. The former is more likely to obtain in parallel or inverted foot-walking, and the latter is encouraged in everted foot-walking, and by far the greater majority of persons walk in the latter manner. This outward rotation naturally throws more body weight and strain on the inner side of the foot (the weak side), and mechanical strain from disturbed balance is the inevitable result. One constantly meets with patients (especially women) who claim they cannot wear low-heeled shoes, and before a contrary statement is made, one should make certain that it is not on account of shortened heel tendons.

In a certain camp, a young man just under the draft age, complained of his feet and that he was unable to drill and work as others. He was called "yellow" and "slacker" and was saddled with all sorts of punishment in the effort to get him to train, but to no purpose. He had been examined frequently, but no flat foot or other cause could be found by the surgeons to explain his disability. I was asked to examine him, and as he stood before me the feet were in a position of abduction, though not extremely so. Inspection of the bared feet showed both heel tendons to be so short that the feet could not be dorsiflexed to within five degrees of a right angle. His shoes were balanced and the tendon shortening was neutralized, exercises were given and in three weeks he was drilling actively and spiritedly with his company.

Many similar cases in civil practice could be cited with equally good results following proper mechanical balancing. When strain is relieved, function becomes painless and normal. I have made it a rule of practice to operate upon these cases when under thirty-five years of age by lengthening the tendon subcutaneously by partial section at different levels and thorough stretching and have had uniformly good results from the procedure. After this age mechanical treatment is preferable, as muscle restoration and the resumption of power and function are not so well assured as in younger persons, though, of course, there are exceptional cases of success. It is claimed by some orthopædic surgeons that the tendo Achillis can be stretched sufficiently to relieve this strain by a rocking heel under the shank of the shoe and by massage, exercises and other means. Phelps experimented along this line and the results of his work do not offer much encouragement to stretching of the tendon. Shaffer and Nutt have each constructed a leverage machine in which to



FIG. 1.—Normal relation of the astragalus, scaphoid and internal cuneiform.



FIG. 2.—Hypertrophy of scaphoid. Abducted test.



FIG. 3.—One small and one large tibial extensor.



FIG. 4.—Two large tibiale externum in a bad case of flat feet.

### THREE FREQUENT CAUSES OF WEAK AND OF FLAT FEET

strap the foot for the purpose of stretching the tendo Achillis, and both have claimed excellent results in these cases of right-angled contraction. Personally, I have never succeeded in elongating one by any shoe alteration or mechanical device and am dubious of its accomplishment, except where the shortening has recently followed wearing of a high-heeled shoe and the fibrous elements have not yet undergone organic change. The simplest and best mechanical device is the elevation of the heel of the shoe or the insert of a pad inside of the shoe under the foot-heel. It is well known that a shoe-heel cannot be raised or lowered more than  $\frac{1}{4}$  inch, without interfering with the lines of the shoe and throwing strain upon the vamp, but a higher-heeled shoe may be prescribed and worn. Also the shoe-heel should not be more than  $1\frac{1}{2}$  inches high in its entirety, as more than this disturbs too greatly the proportion of weight-bearing between the heel and ball and gives rise to other disabilities of as great severity. Frequently it may be advisable to combine with the heel elevation a wedging of the inner edge of the heel and sole to secure adduction of the foot and so throw the body weight directly over the centre of the foot. This again restores balance which is so essential to healthy function on the part of the foot. I have frequently been asked why this wedging could not be done by means of an insole placed inside the shoe, but experience shows that it will not provide the degree of stability and efficient support that the other method does.

The next condition that mechanically predisposes to a weak or flat foot is a hypertrophy of the inner end of the scaphoid bone. When this occurs, the inner border projects inward beyond the line from the border of the head of the astragalus to the internal cuneiform and curls backward along the inner side of the astragalus. In these cases, the articulating surface of the head of the astragalus will often be found to extend further backward on the neck than normally. Dwight, in his atlas of "Variations of the Bones of the Hand and Foot," draws attention to this variation in the shape of the scaphoid and speaks of its fairly frequent occurrence. In the well-balanced foot (Fig. 1) the inner edge of the head of the astragalus and the border of the scaphoid and of the internal cuneiform are in a nearly straight line, but if the scaphoid is prolonged inward (Fig. 2) it forms, by its relation with the inner surface of the head and neck of the astragalus, a mechanical obstruction to adduction of the forepart of the foot. This enlargement is easily felt under the skin, and is commonly mistaken for the head of the astragalus. It can, however, be readily felt to move independently of the astragalus when the forefoot is abducted and adducted. An anteroposterior view of the tarsals with the X-ray will show at once the relations of the two parts. This view must be taken with the feet straight, neither abducted nor adducted, to bring out the accurate conditions of the bones. Attempted adduction of the front part of the foot will be found to be limited by the impingement of the elongated process of the scaphoid upon the head and neck of

the astragalus, and when the foot is thus adducted the process completely covers the head of the astragalus on the inner side. In this position the foot frequently turns inward but little beyond a straight line. The tendon of the tibialis posticus muscle is attached to this portion of the scaphoid, and the insertion covers the entire inner surface of this bone. In this relation of the bone, there is a mechanical disadvantage in the pull of this muscle and its ability to hold the foot in adduction. This disturbance of this pull readily permits a slight degree of abduction, throws a strain upon the remaining structures of the arch and predisposes to the onset of a weak and ultimately of a flat foot. In all of these cases the outward excursion of the forefoot (abduction) is greater than the inward, and when the strain once begins the muscle spasm sets in and the pull of the peronei becomes a very important and very potent factor in the increase of the faulty posture. Walsham and Hughes ("Deformities of the Human Foot") state that, "on the lower part of the convex inner border of the foot (flat foot) may be seen two prominences, the enlarged tubercle of the scaphoid and the head of the astragalus, the prominences being due partly to displacement of the bones and partly to enlargement from chronic periostitis and osteitis, the result of pressure. These prominences are sometimes almost fused together so as to give the appearance of a single prominence, but with a little care a groove between them can always be detected with the finger." In all my cases I have found but one of osteitis, and in that one there was no alteration of position or evidence of weakness. The X-ray does not show inflammatory enlargement of these parts and in those cases operated upon there has been no appearance of inflammation. I believe both of these prominences, therefore, are developmental in character and that when present they have been the determining factors in producing foot strain. In conjunction with these cases it must be remembered that the angle of the neck of the astragalus with the body is also important. When this inclines inward, it increases the tendency to sinking downward of the ankle-joint and internal malleolus, and this hastens the position of weakness and aggravates the disability. I have observed this alteration in many X-ray plates as well as in museum specimens and its importance as a sprain-producing factor must be recognized when it is present.

The third factor which I find frequently, especially in cases of congenitally weak and in flat feet, is a supernumerary tarsal bone placed at the inner side of the scaphoid and over which runs the tendon of the tibialis posticus. This bone is called the tibiale externum and by some has been called a sesamoid in the posterior tibial tendon (Figs. 3 and 4). Dwight ("Variations of the Bones of the Hand and Foot") calls attention to the bone and shows illustrations of anatomic specimens of its various manifestations. It is developed by a separate centre of ossification and may be entirely separated from the scaphoid, looking like a rounded sesamoid; or it may articulate with the inner end of the scaphoid,

### THREE FREQUENT CAUSES OF WEAK AND OF FLAT FEET

having distinct joint structures between them; or it may have a synostosis with only a thin line of cleavage; or it may be firmly fused with the scaphoid, forming a hook-like projection along the inner side of the head and neck of the astragalus. Dwight says, "The tibiale externum is commonly known as the sesamoid in the tendon of the tibialis posticus, but it is a true part of the skeleton, being found in many mammals and being cartilaginous in the second month of the embryo." "It is sometimes quite free, having no close connection with the scaphoid, but, as Pfitzner has shown, it is never inclosed in the tendon." Recently, in operating upon a case of flat foot in a boy seventeen years of age, I found a large-sized tibiale externum lying on the under surface of the posterior tendon after this tendon had been separated from its scaphoid attachment and reflected back to permit removal of the hypertrophied inner end of the scaphoid. It was removed without disturbing the continuity of the tendon.

When this structure is present and there is marked abduction of the front portion of the foot with prominence and convexity on the inner side of the foot in front of and below the internal malleolus, the best procedure is remove the supernumerary bone and the inner end of the scaphoid and make a reattachment of the tendon of the tibialis posticus further forward on the scaphoid or even to the internal cuneiform. After their removal, the foot can be adducted further, but in older cases it may be necessary to thoroughly stretch the structures on the outer side of the foot and even to cut the peroneus longus and brevis tendons, before sufficient adduction can be secured. A subperiosteal implantation of the tendon is made, and it is better to strip off a thin layer of bone with the tendon when separating it from the scaphoid, as this will insure more firm and reliable union for future strain. The foot is held in plaster of Paris ten to twelve weeks in the adducted position until full correction and safe healing have obtained, and when the patient begins walking the shoe must be tilted by a wedge of about  $\frac{1}{4}$  inch in thickness on the inner edge of the heel and sole to guard against strain. This alteration must be worn until the muscles have regained their full tone under proper exercise when the case can be permitted to proceed normally.

TRANSACTIONS  
OF THE  
NEW YORK SURGICAL SOCIETY  
JOINT MEETING WITH  
PHILADELPHIA ACADEMY OF SURGERY

December 8, 1920

DR. WILLIAM A. DOWNES in the Chair

PERICARDIOTOMY FOR SUPPURATIVE PERICARDITIS

DR. EUGENE H. POOL presented a man whose history is related in a paper read by him, entitled "Pericardiotomy for Suppurative Pericarditis," for which see page 393.

DR. HOWARD LILIENTHAL presented a man upon whom he had operated twenty-one years ago for suppurative pericarditis following pneumonia. At operation the pericardium was found very much thickened. The operation was performed in very much the same way as described by Doctor Pool, with the exception that a tube was not used except to wash out the pericardium. The details of the case were published in the *Medical and Surgical Reports of Mount Sinai Hospital*, 1899. According to the man's statements, he is now perfectly well, and Doctor Lilenthal said that though he had not had the opportunity of making an examination recently the man was apparently in perfect health.

DR. ROBERT GRIER LECONTE, of Philadelphia, said the points which Doctor Pool had emphasized seemed to be the correct surgical ones to bring out. But it must not be forgotten that in post-mortem statistics of pneumonia and other grave diseases, suppurative pericarditis might be present when the symptoms in life were masked or not sufficiently prominent to permit of diagnosis. In the second place, it might not have been the cause of death, but only a participant in final dissolution, so practitioners should not be blamed for bringing few patients with pericarditis to the surgeon. Some years ago, Doctor LeConte said, he had been interested in studying the relation of the pleuræ and the pericardium on the right and left sides, and the studies he had then made were illustrated in the pictures which Doctor Pool had shown. The only way of attacking a suppurative pericarditis was to always drain the dependent portion of the sac. Doctor LeConte stated that the first case in which he performed pericardiotomy was in 1900. In that case he resected the fourth and fifth costal cartilages and dissected up the triangularis sterni, which gave a free exposure without wounding the pleura. One could sometimes see the fold of pleura covering the pericardium, but often it was obliterated

## PERICARDIOTOMY FOR SUPPURATIVE PERICARDITIS

by the inflammation, so one could not count upon finding it. The position of the heart within the pericardium would depend upon adhesions taking place prior to the distention of the sac with pus, and therefore before making a puncture the heart should be located with the fluoroscope to prevent injury with the needle. Puncture should be made as near the sternum as possible, in the fifth or sixth interspace, to guard against traversing the pleura. For diagnostic purposes withdrawal of some of the fluid was as necessary as in empyema. When the pericardium was opened no annoyance was caused to the great vessels by gently manipulating the heart and freeing it from adhesions. This freeing of adhesions with draining of the posterior area would probably prevent pocketing or loculation later.

Doctor LeConte said he had never used Dakin's solution in the pericardium, but he believed it was just as applicable to the pericardium as to the pleura, and he saw no reason why we should have a different procedure in the one than we did in the other.

DR. GEORGE P. MULLER, of Philadelphia, said that he was in particular agreement with Doctor Pool as regarding the necessity for drainage at the dependent part of the pericardium. The method of exposure advocated by Doctor Pool was very satisfactory. He did not think that suppurative pericarditis was particularly common except in association with certain forms of empyema. He had seen five cases only and one was operated upon. Two others were not recognized until too late, and in one case timidity on the part of the physician in charge prevented drainage.

With regard to the recess behind the left auricle, considerable space was given to this pouch by Ballance in his recent book on the surgery of the heart. Doctor Muller also had noted that in Doctor Pool's earlier paper much was made of a case in which at autopsy an undrained abscess was found in the heart sac and behind the left auricle. According to Ballance, even dependent drainage would not reach this recess, and he advocated anterolateral drainage, but it was difficult to see how such could be accomplished without seriously threatening the integrity of the pleural cavity.

Doctor Muller offered the following case for the record: A boy sixteen years of age, with a previous history of diphtheria and rheumatism and frequent attacks of tonsillitis two years previously. He was well until two weeks before admission (May 31, 1915) to the University Hospital, at which time he complained of dyspnoea, palpitation and swelling of the ankles. There was a dull pain over the liver and heart, and cough. The pain was worse on inspiration. The boy thought the symptoms came on shortly after lifting a heavy weight. Physical examination of the chest revealed cardiac dulness as beginning at the second rib and extending to the upper border of the sixth, being greatly widened to right and left. The apex beat was noted in the fourth interspace within two cm. of the limit of dulness. There was a blowing systolic murmur at the

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apex, but no arhythmia. In the third interspace there was a to-and-fro friction rub. The blood count showed 16,000 (71 per cent. polymorphonuclears) leucocytes. X-ray examination revealed the presence of a large pericardial effusion.

Operation was performed in the University Hospital, June 5, 1915. Intratracheal ether anaesthesia was employed. An oblique incision three inches long was made to the left of the sternum over the sixth rib. One inch of the cartilage of this rib was removed. The muscles were pushed aside and the pericardium grasped, opened and its cavity explored. Several ounces of the bloody serum were evacuated and the heart found lightly adherent to the pericardium. About six more ounces were evacuated after separating these adhesions. Arhythmia and extra systoles were noted when the heart was touched. A rubber tube was sutured into the pericardium projecting inwards about one inch and the wound closed around it. The recovery was uneventful, and nine days later the tube was removed and not replaced. The fluid evacuated was found to contain many pus-cells and blood-cells; it was examined bacteriologically, but unfortunately this was not attached to the record.

DR. WILLY MEYER reported a case of chronic inflammation, a sero-sanguino-fibrinous pericardial effusion, in a tuberculous patient, thirty-three years of age. This patient was operated upon at the Lenox Hill Hospital in 1908. The left pleural cavity had been repeatedly aspirated and large quantities of clear serous fluid evacuated. The X-ray examination showed an enlargement of the pericardium and aspiration was performed by him. The puncture was made in the fifth intercostal space, close to the sternum, and 1200 c.c. of a dark fluid evacuated. The patient improved at once, but in one week a second aspiration was required, and 1000 c.c. withdrawn. After six days incision and drainage were absolutely indicated. In doing the operation the same method mentioned by Doctor Pool and Doctor Lilienthal was employed. Under local anaesthesia the sixth and seventh costal cartilages were resected and the internal mammary vessels tied and cut to get the proper access. The pleural cavity was first tapped and then the parts were pulled aside and an incision made into the pericardium. More than two quarts of fluid were evacuated. A drop-light was then used to inspect the pericardium, and the finger introduced to feel the heart beat. No pulsations could be made out. Then with stick sponges large quantities of fibrinous material were removed. The fingers now again introduced into the pericardium could feel the heart pulsations. Often in these cases of chronic effusion very large amounts of fluid were present (quarts) which was easy to understand, as the mediastinum could expand bilaterally as well as posteriorly. The first thing to be carried out in these patients after the usual clinical examination was an X-ray examination; then the aspirating needle should be used. Repeated aspiration was contraindicated; free incision of the pericardium with thorough drainage should always be

#### CHOLECYSTO-DUODENAL FISTULA

made, and fibrinous coagulations, as found in chronic effusions, thoroughly cleared out.

Doctor Meyer stated that he had seen this patient one year after the pericardiotomy was performed and he was then in very good condition. He was presented with the wound healed before the Surgical Society in 1909.

DR. WILLIAM DARRACH reported a case of suppurative pericarditis occurring in a very sick negro. Drainage was instituted under local anaesthesia with considerable difficulty. The man returned later with pericardial adhesions and general anasarca, and died.

DR. JOHN H. JOPSON, of Philadelphia, spoke of the use of the Carrel-Dakin method in the pericardium. He had operated on a young man last spring, who had what proved to be a general staphylococcus infection, beginning in the accessory sinuses. Admitted to the Presbyterian Hospital when very ill, a laryngologist operated upon him for this, and later Doctor Jopson was called to see the patient for a suspected pleural involvement. After two weeks an empyema developed on the right side, also of staphylococcal origin. This was drained under local anaesthesia. Soon after the boy began to suffer from cardiac embarrassment, and the X-ray showed a large pericardial effusion. At operation under local anaesthesia a single costal cartilage, the fifth, was resected. Doctor Jopson said he then began to use the Carrel-Dakin treatment with some trepidation. The empyema on the right side was simultaneously Dakinized. The left pleura was aspirated several times for a reaccumulating collection which remained serous. The Dakin solution was badly borne in the pericardium, and caused cardiac embarrassment, the fluid apparently being too thick and gelatinous after mixing with the pus, and it had to be given up. The patient made a strong fight for life, and finally died after an illness of more than eight weeks. An antistaphylococcal serum was also used. Doctor Jopson expressed the opinion that the method of drainage described by Doctor Pool was a most valuable one, superior to any hitherto described, and would certainly replace the old method of single cartilage resection which gave poor drainage, while this was ideal. The Carrel treatment failed in his case because of the absence of dependent drainage which was advisable here.

#### GASTROENTEROSTOMY IN PERFORATING ULCER OF THE STOMACH

DR. JOHN B. DEAVER, of Philadelphia, read a paper with the above title, for which see page 441.

#### CHOLECYSTO-DUODENAL FISTULA AND ULCER OF THE LESSER CURVATURE

DR. JOHN F. ERDMANN presented a man, fifty-three years of age, who one year ago began to suffer from abdominal distress four to five hours

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after eating. Later he began to vomit. The vomiting had existed for the major portion of the past year and consisted of mucus to food taken the day before. There had been a slight loss in weight—five to seven pounds. He had never had any severe pains, never been bedridden, and never been conscious of losing blood, either by mouth or rectum.

November 6, 1920, he was operated upon for ulcer of the duodenum. Upon exposure it was found that profound adhesions existed between the gall-bladder and duodenum with calculi in the gall-bladder and a fistula between an old perforated duodenal ulcer and the gall-bladder. In addition, an ulcer of the size of a twenty-five-cent piece was disclosed upon the lesser curvature and posterior wall of the antrum. The appendix was atrophied. A cholecystectomy was done, in addition to closing the duodenal ulcer opening, and a typical Balfour excision of the gastric ulcer. The appendix was not disturbed.

### DUODENAL FISTULA FOLLOWING CHOLECYSTECTOMY, WITH FOREIGN BODY

DOCTOR ERDMANN presented a woman, thirty-nine years of age, who was seen by him October 14, 1920. She gave a history of having been operated upon for gall-stones and appendix in New York City on May 26, 1920; again on June 1st, ostensibly for adhesions, with pus and bile leakage, accompanied with chills and fever; again on August 19, 1920, for a pus pocket. On the day Doctor Erdmann saw her she presented a fistula in the right upper quadrant, but no apparent bile. She stated that she had at one time discharged what looked like coagulated milk. There had been no chills since the third operation. She had lost forty pounds in weight. She said that her operating physician had to pack her wound during the second operation because of bleeding. She had required two dressings a day to keep her comfortable. A diagnosis was made of intestinal fistula, or foreign body.

A few hours before operating upon her Doctor Erdmann was called by telephone and advised by another physician that he had assisted at the third operation and removed quite a piece of gauze. Operation, on October 19, 1920, revealed dense adhesions. The sinus enlarged as deep approach was made. No gall-bladder was present. A foreign body, a piece of gauze, rolled like a cigar, four inches long and one-half inch in diameter, and foul smelling, was found. Removal of this revealed a hole, with indurated and irregular edges and large enough to admit a silver quarter, in the upper surface of the first portion of the duodenum.

Suture of the opening was made in three tiers, and a gastroenterostomy was done. The patient was discharged from the hospital in twenty-nine days, with only a small spot of granulation at the site of the original drain.

## PERFORATED GASTRIC AND DUODENAL ULCER

### ABDOMINAL SINUS; SUBPHRENIC ABSCESS; CHOLECYSTO-DUODENAL FISTULA

DOCTOR ERDMANN presented a woman, fifty-one years of age, who was first seen by him September 22, 1920. One year before, in Nebraska, she had been operated upon for gall-stones, remaining three months in the hospital. She left the hospital with a persisting fistula. In November, 1919, she went to Rochester, Minnesota, and while under observation there her fistula closed. She was told by one of the physicians to return in a year to have her gall-bladder removed. Two months before seeing Doctor Erdmann she began to have pain in the operated region, and in a few days the old sinus reopened and discharged pus and blood. She had lost considerable weight and presented the appearance of secondary anaemia, characteristic of malignancy. There was a most foul, brownish, free discharge from the sinus, which she stated required from two to five dressings a day. No bile color observable.

While under observation in the Post-Graduate Hospital she ran a temperature of from  $99\frac{1}{2}^{\circ}$  to  $103^{\circ}$  per rectum. She was anaemic, with a blood count of 3,500,000 red-cells; haemoglobin, 47; no marked differential.

*Operation* (October 1, 1920) revealed an atrophied gall-bladder well below the liver border, densely attached to the colon, with a perforation into the duodenum, and a large subphrenic abscess holding over two pints of gray to brown pus, most foul smelling. The gall-bladder, upon removal and section, showed the half of a large white grape in it. The duodenal connection was closed. The subphrenic abscess was drained into the midaxillary line and through the abdominal wound. The patient was discharged from the hospital in five weeks with a small sinus in the right axillary line.

## PERFORATED GASTRIC AND DUODENAL ULCER

DR. CHARLES H. PECK presented two cases, illustrating operative results in cases of perforated gastric and duodenal ulcer. The first case was that of a man upon whom Doctor Peck had operated for perforated duodenal ulcer in 1904. The operation was performed four hours after the acute onset of symptoms and consisted in a suture of the ulcer without gastroenterostomy. The man made a good recovery. He was followed up for a number of years, during which time he was in good health; he was then lost sight of until February, 1919, when he presented himself, complaining of a recurrence of ulcer symptoms, from which he had been free for a period of thirteen years after simple closure without gastroenterostomy. He now presented evidence of duodenal stricture as shown by the X-ray and corroborated by physical signs. A posterior gastroenterostomy was performed in February, 1919, almost two years ago. Doctor Peck said he presented this patient to illustrate the end-result in operation for ulcer, in the first place, and in the second place, because of the long interval that might exist before the development of a stricture

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which required further treatment. There was nothing special in the detail of the case, it being a typical case of ulcer at the time of onset.

The second case also had an interesting and prolonged history. This patient Doctor Peck operated upon in 1907, thirteen years ago, for an acute perforation on the anterior wall of the stomach. The perforation was at the middle of the anterior wall; closure was effected by a simple suture without gastroenterostomy. Following this operation the patient went along in fairly good health until 1911, when she presented herself, complaining of indigestion and gastric pain and distress. The X-ray examination showed a typical hour-glass stomach, for which an anterior gastrogastrostomy, giving nearly four fingers' opening, was performed in January, 1911. The patient made a good recovery and was relieved of her symptoms for a few months. In September, 1911, she was operated upon for an acute gangrenous appendix which had perforated with the formation of a retrocaecal abscess. At both previous operations she had been so seriously ill that they had not thought it advisable to prolong the operation by performing an appendectomy. In 1915 she complained of some chronic indigestion and returned to the hospital, where an X-ray examination was made which showed the gastrogastrostomy functioning well with a broad opening which had not contracted much in the meantime. She suffered a certain amount of gastric distress in 1916, but this passed on without further operative treatment, and she was now comfortable and in good health.

DR. ASTLEY P. C. ASHURST, of Philadelphia, said he agreed with Doctor Deaver in practically everything he had said, but he regretted that he had not told how many patients died without operation, for those deaths should be added to the mortality statistics. It was not so much the mortality from operation as the number of deaths from the disease that should concern us. He thoroughly agreed that it was proper to do a primary gastroenterostomy in perforated ulcer if the patient's condition permitted.

DR. CLARENCE A. McWILLIAMS said that he had looked over the records of the Presbyterian Hospital for the past four years and found that there had been a total of twenty-one patients admitted with perforated gastric and duodenal ulcers, four of whom died after operations, or 18 per cent. Nine of this total had immediate, primary gastroenterostomies performed with two deaths, or 22 per cent., while twelve had not had gastroenterostomies, of whom two died, or 17 per cent.

It was unquestioned that those upon whom gastroenterostomies were performed were picked as the best risks, consequently the mortality was sure to be greater in those upon whom a gastroenterostomy was indiscriminately performed than those without. The after-results are interesting. There were twelve cases which had no gastroenterostomy at the primary operation, two of whom died, leaving ten to be followed; of these ten, two were cured, or 20 per cent.; two were improved, or 20 per cent.; while six were unimproved, or 60 per cent.; three of these unimproved

## PERFORATED GASTRIC AND DUODENAL ULCER

six had subsequent gastroenterostomies without mortality and one had a subsequent perforation with death resulting after operation. Consequently, it could be said that the after-results were not brilliant among those upon whom no gastroenterostomy was done. Of the nine cases with primary gastroenterostomy, the after-results were too few to be illuminating. Of these nine with primary gastroenterostomy, two died as a result of the primary operation, leaving seven to be followed; of these seven, three were cured, or 42 per cent., while four could not be followed.

From these small statistics, the position of Doctor Deaver, as to the poor after-results, seemed to be confirmed. It certainly might be wise for the expert to add a gastroenterostomy, provided the operator thinks the life of the patient would not be jeopardized. The casual operator, however, had better not yield to the temptation to do a gastroenterostomy. It would seem to be a mistake to lay down the dictum that every perforation of a stomach or duodenal ulcer must have a gastroenterostomy at the primary operation, for this would be followed by an unnecessarily higher mortality. Stenosis of the pylorus caused by the infolding of the perforation is usually regarded as an indication for a gastroenterostomy, yet even this is not an absolute indication, for nature overcomes a considerable constriction of the pylorus. This is shown by the large number of statistics collected from many sources by Doctor Eliot, in which it was proved that in only one or two instances among the entire series was a gastroenterostomy necessary within a few weeks of the primary operation performed for acute perforation. Whether the slightly increased mortality attendant upon a primary gastroenterostomy would be offset by the mortality following the secondary operations required in a certain proportion of cases to effect a cure, a large number of cases alone would tell. So far as perforations of gastric ulcers alone were concerned, a secondary operation would allow a procedure to be performed which would be more certain to cure than a gastroenterostomy, namely, pylorectomy, if the ulcer were near the pylorus.

### PERFORATED ULCERS

Total, 21 cases, 4 deaths, or 18 per cent.

1. Without gastroenterostomy—12, 2 died, or 17 per cent.

2. With gastroenterostomy—9, 2 died, or 22 per cent.

A. Gastric, 11, with 1 death, 9 per cent.

With gastroenterostomy, 5; 1 death.

Without gastroenterostomy, 6; 0 deaths.

B. Duodenal, 10, with 3 deaths, 30 per cent.

With gastroenterostomy, 4; 1 death.

Without gastroenterostomy, 6; 2 deaths.

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AFTER-RESULTS

With primary gastroenterostomy, 9 cases.

2 died.  
3 cured.  
3 could not be followed.  
1 too early to be followed.

Without primary gastroenterostomy, 12 cases.

2 died.  
2 cured.  
2 improved.  
6 unimproved, 3 of whom had subsequent gastroenterostomies, while 1 had a subsequent perforation, with death after operation.

DR. ELLSWORTH ELIOT, JR., said that, if Doctor Deaver referred to a paper he had written some years ago, he erred in his statement that seventy-five instances of secondary operation after a primary suture of a gastric or duodenal ulcer were cited. The number of these cases was much smaller; in fact, their percentage was not as large as in those cases collected in which there was trouble after a gastroenterostomy without perforation. Some of these latter patients had so much trouble that the gastroenterostomy had to be revised and some other operative measure applied for the relief of the ulcer. Doctor Eliot said he would agree that in perforated ulcer primary gastroenterostomy done by Doctor Deaver's skilful hands, or by hands equally skilful, would not add to the mortality of the operation, but it was perhaps unwise to induce the surgeon of less dexterity to prolong the operation in this way, for under certain circumstances it might easily jeopardize the life of the patient. In a questionnaire, in connection with the paper referred to, sent out to a number of surgeons, chiefly members of the American Surgical Association, asking their opinion in reference to the performance of primary gastroenterostomy in cases of perforated ulcer, a number answered that they were convinced that the prolongation of the operation necessary for the addition of gastroenterostomy resulted in additional fatalities. The consensus of opinion seemed to be that it was safer to limit the operation to closure of the perforation, and, subsequently, if necessary, to do a secondary gastroenterostomy. Usually a secondary operation was not required, or if required it might be, as in Doctor Peck's case, many years after the closure of the perforation. A secondary operation could be done with much less risk, particularly in relatively unexperienced hands. In recent perforations without extensive peritonitis, and in skilled hands, a primary gastroenterostomy was frequently justified, but in delayed cases coming to the surgeon twenty-four to forty-eight hours or later after the perforation with extensive peritonitis, the patient's chances of

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recovery are better if the perforation is merely closed. If the patient recovers and the gastric symptoms persist, a secondary gastroenterostomy can then be performed. It is interesting and important to note that the secondary operation is rarely necessary, if at all, before the expiration of several months, and frequently much later. Doctor Eliot said so far as he knew it had never been performed before the tenth day. In other words, the gastroenterostomy is done, if indicated, after the patient has fully recovered from the effect of the primary operation.

DR. JOHN F. CONNORS agreed with Doctor Deaver in all the things he said, but took exception to the performance of a gastroenterostomy in perforated ulcer as a routine measure. He cited the following statistics from a paper he had published in 1916 in which he presented an analysis of forty-two cases of perforated ulcer. Since that time there had been twelve additional cases. Of these cases 72 per cent. were simple closure by suture. In these cases 70 per cent. recovered and 30 per cent. died; in 28 per cent. of the cases a gastroenterostomy was performed at operation; 33½ per cent. recovered and 66½ per cent. died. In many of the cases which were done by suture he felt that in a large number he had lessened to a great extent the calibre of the pylorus, and it appeared at the time of operation that little if anything could pass through, but in only two of them was it necessary to perform a gastroenterostomy at a later date; one after six weeks and the other three months.

Doctor Connors said he had seen two of the cases closed by suture, one after three years, which died of pneumonia; at autopsy there were absolutely no evidences of ulcer to be found. The other was a patient who had an active tuberculous condition of the lung at the time of his perforation. He was operated two years later for a tuberculous peritonitis and no evidences of ulcer were to be seen.

Doctor Connors said that gastroenterostomy in the hands of Doctor Deaver was a safe procedure, but Doctor Deaver had well said "in the hands of a master"; unfortunately, most of us were not masters but unskilled. Therefore, he maintained that simple suture was the operation in perforated gastric ulcer.

DR. CHARLES H. PECK said that when he looked over the series of perforated ulcers for the past eight years, on the Second Surgical Division of the Roosevelt Hospital, he found twenty-one cases, and these histories showed that they had frequently done primary gastroenterostomies. If a primary gastroenterostomy implied an additional surgical risk it was left for a secondary operation. In making the decision as to whether or not to do a primary gastroenterostomy it made a great deal of difference in what condition the patient was and how long a period had elapsed since the perforation. In this series of twenty-one perforations, there were twelve primary gastroenterostomies and nine simple closures. There were three deaths in the first series, a fairly high mortality. In the cases closed without gastroenterostomy there were many which were

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severe cases. Doctor Peck said he believed gastroenterostomy could be done safely in many early perforations where there was not much soiling; it could be done quickly without causing much shock to the patient, and the chances for a permanent cure were distinctly better.

Doctor Peck recalled a perforation operated upon in 1909 after twenty-nine hours, when the abdomen was full of exudate. That woman could not have stood gastroenterostomy. He had followed her for fourteen years and she had remained perfectly well without a secondary operation, and without the persistence of gastric symptoms. On the other hand, there were some cases requiring secondary operation. There were four cases requiring secondary gastroenterostomy, one fifteen years after the perforation; another eleven years after, in both instances with a good interval of freedom from symptoms. The two others required the secondary operation within shorter periods. In one of these, a man seventy-one years of age, a second operation was required within twenty-one days. This patient had a fixed duodenum and an attempt was made to suture the perforation, with the result that a fistula formed which closed in about three weeks, with complete closure of the pylorus. At this time he was in a desperate condition physically, and demented also. He was now seventy-four years old and well. In another case the secondary operation was done thirty-two days after the first. In a good many cases if it could be done without increasing the mortality an immediate gastroenterostomy had its advantages, but, on the other hand, there are a good many cases in which fifteen or twenty hours after perforation there was a good deal of exudate and it was better policy to close the perforation and take a chance of having to do a secondary gastroenterostomy.

DR. JOHN A. HARTWELL said that one got the impression from the paper and the discussion that statistics on this subject were of very little value, as they varied so much in the different clinics. He felt that one could scarcely lay down a rule of practice, but that each case must be considered on its merits. He had understood Doctor Deaver to say that he had never seen a perforated ulcer that could not be properly closed, and he wondered that if possibly some of the deaths reported had not been due to the failure of union or an incomplete closure, with a resultant peritonitis.

Another point brought out by Doctor Hartwell was that the production of gastroenterostomy was not a natural procedure, and a person with a gastroenterostomy was not a normal person. He had gone on the principle that the surgeon who performed a gastroenterostomy must show cause why he should do it. In other words, a gastroenterostomy was not something to be done because it was convenient, but one must show why it was a good thing. If there was an obstruction at the pylorus after the perforation was closed, then gastroenterostomy should be considered. If the patient was in good condition and there was reason to think the stomach sufficiently deformed so that the musculature would

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not properly function, a gastroenterostomy should be performed. Otherwise the stomach should be left in as nearly a normal condition as possible until subsequent evidence made a secondary operation advisable. Gastroenterostomy in itself was justly considered as largely a curative measure for pyloric and duodenal ulcers. It, however, was not curative for gastric ulcers, and hence the necessity of its employment in gastric perforations was less apparent than in duodenal perforations.

DOCTOR DEAVER, in closing the discussion, said that, speaking of the surgeon with large experience and of the occasional surgeon, the occasional surgeon should not do a posterior gastroenterostomy as a routine procedure. Most of their posterior gastroenterostomies were done in early perforations. Patients operated upon after seventy-two hours practically all died whether suture alone was done or a primary gastroenterostomy added. The success of this procedure depended upon its being done early. In diffuse peritonitis few surgeons would perform a gastroenterostomy, but done in the early stage by a well-trained surgeon it was safer than simple suture, because there was less likelihood of leakage, and he believed that was one reason why it had been followed by better results. One must not lose sight of the fact, as one of the speakers had remarked, that from the physiological standpoint it might be better to go on with the stomach in its natural condition, but it must be remembered that many people with posterior gastroenterostomies were just as well as those who had never had anything wrong with their stomachs. The 80 to 90 per cent. of cures recorded by Moynihan, the Mayos, and others followed up, afforded proof of this statement.

## BOOK REVIEWS

**PARACELSUS:** His personality and influence as physician, chemist and reformer. By JOHN MAXSON STILLMAN, Professor of Chemistry, Emeritus, Stanford University. The Open Court Publishing Company, 1920. Cloth, 8vo., pp. 184. Chicago.

For some reason or other Paracelsus has been brought into notice in connection with the development of medicine to a much larger degree than his real worth would seem to merit. No one of the catalogue of medical worthies has been the subject of greater dispute as to his character; by many he has been considered as almost beneath contempt, while by others he has been exalted as a great medical iconoclast, whose privilege it was to usher in a new dawn in medicine. There are some things about him, however, about which there is no dispute. He was a medical tramp, never contented to remain long in any one place. As an army surgeon he had participated in wars in Denmark, Sweden, and Italy. In his further wanderings he visited England, France, Belgium, Portugal, and Spain. He traversed much of Germany, Moravia, Hungary, and Carinthia, visiting many places and remaining long in no place. At the age of thirty-three he reached the summit of his achievements in an appointment as the city physician of Basel and professor in its university. This appointment was due to the influence of the distinguished book publisher, Froben, who had been relieved by Paracelsus of a painful illness which had defied the efforts of many physicians. But a year did not elapse before the storm which his personality and methods and doctrines caused to gather about him was so great as to make him glad to leave Basel and start again upon his peripatetic career. After fourteen years more of wandering, he died September 24, 1541, at Salzburg, in the forty-eighth year of his age.

Portraits of Paracelsus in his later years show him as apparently a very old man, doubtless the result of the irregularities of his life and the tempestuous nature of his mental processes.

Paracelsus was a born fighter. In some respects he reminds us of his theological contemporary, Martin Luther. In his contempt for tradition he suggests to us his other contemporaries, Vesalius and Paré. The elements of his character which dominated his work, however, were the extravagance and positiveness of his claims, the savageness of his attacks upon those who disagreed with him, his overweening egotism which destroyed all proper perspective in his views of men and affairs, which had its fruit in an intense charlatanism in the practical affairs of medicine. Like all charlatans that blow their trumpets loud and long and make claims for abilities which results do not substantiate, it was easy for him to attract immediate notice wherever he went, a notice sure to be turned

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into such discredit within a short time that he was glad to soon move on to another place of labor.

There is no reason to suppose that Paracelsus did not believe all that he claimed for himself. It would be interesting if some psychoanalyst of the present day would make a study of Paracelsus as he is revealed in his writings. He was an intense man in all the relations of life. If we study his character and the times in which he lived, we are unable to see in him a great reformer; he belonged to the destructive type rather than to the constructive type of men. He could not have been a very pleasant man to live with.

He was a picturesque character, the product of his times. And his protests against the absurdities of the medical practice of his time, and his suggestions as to the value of simpler and especially of chemical remedies show him to have been a man of vision.

The manuscript works in which his views were set forth were voluminous.

Professor Stillman has given us in this little book an excellent study of all that is known about Paracelsus. During recent years much scholarly research, notably by German writers, has been brought to bear upon the life history of Paracelsus. Upon the results of this research the author has freely drawn. There is no intelligent physician who is interested in the history of his profession who will not gain from this book of Professor Stillman a new and better understanding of the personality, accomplishments, and influence of Paracelsus.

LEWIS S. PILCHER.

DISEASES OF THE EAR. By PHILIP D. KERRISON, M.D., Aural Surgeon to the Willard Parker Hospital for Infectious Diseases. Second Edition, Revised and Enlarged. J. B. Lippincott Company. Philadelphia and London.

Kerrison's admirable work on the diseases of the ear, which was published first in 1913, has just reappeared in an edition with some revisions by the author. From the time of its first appearance the work has continued to enjoy a very wide popularity, its clear and direct style and the comprehensive presentation of the entire field seeming to render it both an admirable text-book and also an excellent work for the specialist and general surgeon for checking up personal experiences. Kerrison's book may be said to have been the first formal American treatise to gather the mass of comparatively newly investigated and research material on the static labyrinth and incorporate it as a part of his treatise. This was carefully done, and its convenient form and thoroughness has met with the approval of otologists very generally. In the section devoted to the labyrinth the author reviews the anatomy of the labyrinth, its physiology as generally accepted, and the grounds on which the modern theories of

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its function have been proved; and also labyrinthine diseases and their symptoms, their remedies and the methods of surgical intervention, when the disease is of a suppulsive nature and of a type to receive benefit therefrom. It is not surprising that this portion has been in small part revised, since the present-day theories regarding this field are still in process of crystallization. The chapter on the effects of syphilis upon the labyrinth has also been in part rewritten. The writer of this notice of the work can but congratulate the author for the successful presentation of a conscientiously performed, well-proportioned task.

WILLIAM C. BRAISLIN.

**SURGICAL PATHOLOGY AND MORBID ANATOMY.** BY SIR ANTHONY A. BOWLBY, K.C.B., F.R.C.S., AND SIR FREDERICK W. ANDREWES, M.D., F.R.S. P. Blakiston's Son and Co., Philadelphia, Pa.

The work under consideration consists of one volume containing 651 pages with 210 illustrations, and appears as the seventh edition.

For the undergraduate as well as for the graduate the general plan of the book is excellently adapted for a brief but comprehensive reference on surgical pathology. There are seventy-four chapters of which the first eight deal with hyper trophy and atrophy, degeneration, microorganisms in their relation to surgical pathology, inflammation, suppuration, healing of wounds, surgical fever and inflammatory leucocytosis, supræmia, septicæmia, and pyæmia.

Of the next sixty-six chapters, fifty-four deal with diseases most frequently encountered during life. Their natural courses and terminations are briefly related, and the morbid appearances presented by the structures involved are admirably described. In general, one disease, or one pathological condition, as the case may be, is begun and finished in a single chapter. There are, however, three chapters devoted to diseases of the bones and three to diseases of the joints.

The remaining twelve chapters are devoted to the pathology of shock, tumors (four), cysts, contusions, hemorrhage, fractures and dislocations, blood-vessels, nerves, and gangrene.

Most excellent and pertinent plates are numerous throughout the book. There are a few good photomicrographs. Most of the illustrations, however, are devoted to photographs or drawings showing the gross pathology of the lesions under discussion.

Before the presentation of this last edition a complete revision of the older work was accomplished and new drawings were added. Recent war experiences have prompted the addition of fresh chapters on gas gangrene, shock, and tetanus.

The reviewer considers that this work is certainly worthy of its present new edition, and predicts for it a useful and successful future.

MERRILL N. FOOTE.

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**VENEREAL DISEASES, THEIR CLINICAL ASPECTS AND TREATMENT.** By I. E. R. McDONAGH, F.R.C.S., Surgeon, London Lock Hospital. William Heinemann, London, 1920.

This is a compendium on venereal disease profusely illustrated with color and half-tone plates. Each plate has beside it a concise description of what is to be seen which greatly assists the reader. It is written by a man who, from his position as Surgeon to the London Lock Hospital, has had abundant experience in every detail, and who has made full use of his great opportunities in observing and recording his impressions. These he has given in an impressive way in the thirty-four chapters in the volume before us.

The various problems concerning the prevention of venereal disease are discussed and the opinion expressed that if it were made compulsory to attend an ablution centre within one hour of exposure, almost a guarantee can be given that infection will not ensue—but his own opinion is that no measure short of one akin to vaccination against smallpox will be really successful in ridding the world of venereal disease.

Syphilis has been gone into very fully and treated in an interesting manner. One of the best short chapters is that on the clinical aspect of syphilis of the nervous system. The writer accepts the view that tabes and G.P.I. are not clinical entities but merely the end-results of a previously undetected lesion. He shows the influence which syphilis of the vessels has on the causation of the purely nervous manifestations, a view which is still further strengthened by the frequent occurrence of degenerative encephalitis following early hemiplegia. The author enters very fully into the treatment and makes careful discrimination between the various methods employed.

The whole volume is well written, the lucid explanations and the concise statements make it eminently readable, and as the information is up to date it makes an admirable volume for students and practitioners.

WILLIAM MACEWEN.

**SURGERY: ITS PRINCIPLES AND PRACTICE, FOR STUDENTS AND PRACTITIONERS.** By ASTLEY PASTON COOPER ASHHURST. Second edition, thoroughly revised. Lea & Febiger, Philadelphia and New York, 1920.

The second edition of Ashhurst's "Principles and Practice of Surgery" has appeared as a natural sequence to the favor and demand with which the earlier edition was received by both practitioners and students. New matter has been introduced, some sections have been entirely rewritten and the whole text has been revised and brought up to date. Although the volume is somewhat larger than in the first edition, it is nevertheless characterized by the same conciseness of expression and omission of the unessential.

The chapters on reconstructive surgery, infected wounds, empyema,